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A STUDY OF AUDITORY BLENDING ABILITY AND ITS RELATIONSHIP TO READING ACHIEVEMENT IN GRADE II

by

ETHEL GEORGINA CARRAN

A THESIS

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The undersigned certify that they have read, and recommend to the Faculty of Graduate Studies for acceptance, a thesis entitled:

A STUDY OF AUDITORY BLENDING ABILITY AND
ITS RELATIONSHIP TO READING ACHIEVEMENT IN GRADE II

submitted by

ETHEL GEORGINA CARRAN

in partial fulfilment of the requirements for the degree of

MASTER OF EDUCATION

ABSTRACT

Skill in phonic analysis of words depends upon the individual's ability to discriminate sounds and to combine them into words. However, several authorities suggest that many children experience difficulty in reading because they seem unable to blend sounds auditorily to form words.

The purpose of this study was to determine certain aptitudes and characteristics which might be related to auditory blending ability, and to examine the relationship between auditory blending ability and reading achievement of children who were in their second year of school.

The sample was comprised of two groups: the good auditory blenders, twenty-five children who scored highest; and the poor auditory blenders, twenty-five children who scored lowest on the *Roswell-Chall Auditory Blending Test*. Children who had hearing deficiencies and gross speech impediments were excluded from the group of poor blenders. Aptitudes measured were auditory discrimination, auditory memory and laterality. Tests measuring sight vocabulary, word attack skills, comprehension and spelling ability were administered.

Findings resulting from the analysis of the data, using the statistical technique of multiple linear regression, included the following:

1. Auditory blending ability was not a significant predictor of reading and spelling achievement.

2. The ability to discriminate and categorize vowel sounds was a strong predictor of reading and spelling achievement.
3. To a lesser degree, memory span for letters was a significant predictor of reading and spelling achievement.
4. Girls demonstrated greater maturity in linguistic ability than did boys.
5. Mental age was reflected in spelling ability.
6. I. Q. was not a significant predictor of reading and spelling achievement in the second year of school.

On the basis of this investigation it would seem that auditory blending ability does not warrant the emphasis that some authorities would give it. In view of the importance of vowel sounds at the second year level, it was suggested that the teaching of vowels and vowel sounds might be introduced at the first grade level. In addition, since memory span contributes to success in reading and spelling achievement, it was suggested that games and techniques should be employed at the kindergarten and first grade level to develop this aptitude.

Since relatively few studies limited to disabled readers or to school-age children have been conducted on auditory blending, it was recommended that further investigations might be undertaken at the pre-school or kindergarten levels. Further exploration at this level might help to clarify the role of auditory blending in reading achievement.

ACKNOWLEDGEMENTS

The writer wishes to acknowledge with thanks the consistent guidance and encouragement given to her throughout this study by her chairman, Dr. Robert Armstrong. To the other members of the committee, Dr. Jean Robertson and Dr. Geraldine Farmer, appreciation is extended also.

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THE PROBLEM

I. INTRODUCTION TO THE PROBLEM

The value of phonics, that is, the study of speech sounds and their printed equivalents, and their function in pronouncing printed symbols, is generally accepted since phonics instruction is an integral part of reading programs using basal readers. Phonics is recognized as a useful means of developing independence in reading in that it aids the child in "unlocking" new words by means of sound analysis, or it provides him with clues which, along with context, enable him to make the correct choice of a possible word. However, skill in phonic analysis of words depends upon the child's ability to single out and distinguish sounds and to combine or blend these sounds into a total word.

It is the process of blending which presents a problem for many children. Schonell points out that twenty to twenty-five per cent of the child population experiences difficulty with the analysis and synthesis of words.[1] Harris states: "There are many children who know the individual letter sounds but seem unable to blend the sounds into words."[2] He notes further, that the ability "to listen to the pronunciation of a word sound by sound and fuse or blend the sounds mentally so as to be able to recognize the word intended," is the most

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[1] Fred J. Schonell, Backwardness in the Basic Subjects (Toronto: Clarke, Irwin and Company, Ltd., 1942), p. 132.

[2] Albert J. Harris, How to Increase Reading Ability (New York: David McKay Company, Inc., 1965), p. 209.

difficult aspect of phonic readiness. He continues:

> While some children find it easy to blend sounds when they enter the first grade, other children go through school without ever becoming skillful at phonic blending.[3]

Bond and Tinker suggest that many children have a reading difficulty because they lack ability in word synthesis. They find it difficult to blend a word auditorily once it has been pronounced part by part or they lack the capacity to blend sounds orally.[4] Vernon outlines two aspects of a systematic procedure in learning to read: first, the ability to recognize shapes and sounds of separate letters, and secondly, the ability to analyze words into phonetic units with a single characteristic sound. The second process according to Vernon:

> ...appears to present the greatest single stumbling block to learning to read...because systematic analysis of words into letters or phonetic units, associating the correct sounds to these, and blending these sounds into whole words, together constitute a procedure necessitating logical reasoning processes which are difficult if not impossible for young children.[5]

De Hirsch, too, notes:

> In order to read a little word like "hat," a sequence of letters seen, a sequence in space has to be translated into a sequence of sounds heard, a sequence in time.[6]

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[3] Ibid., pp. 331-332.

[4] Guy L. Bond and Miles A. Tinker, Reading Difficulties: Their Diagnosis and Correction (New York: Appleton-Century-Crofts, Inc., 1957), p. 294.

[5] M. D. Vernon, "The Perceptual Process in Reading," The Reading Teacher, XIII (October, 1959), p. 5.

[6] Katrina de Hirsch, "Tests Designed to Discover Potential Reading Difficulties at the Six-Year-Old Level," American Journal of Orthopsychiatry, XXVII (July, 1957), p. 567.

She feels that without a certain measure of perceptual, motor, conceptual and behavioural maturation the child will be unable to cope with this task.[7]

An attempt to reduce failures in reading through the introduction of a phonemic alphabet has not succeeded in eliminating the difficulty associated with the blending of sounds to form words. Mazurkiewicz points out the persistence of this problem:

> In nearly all cases (either with the retarded reader, the dyxlexic, the mentally retarded, the slow child, or the child from a poor socio-economic environment), the problem area noted in phonics work in T. O.--blending sounds to form words--also occurs in i/t/a work. A variety of procedures is required to aid the development (or catching) of this concept....Whatever the procedure used, it is noted that this concept of blending is caught only after numerous repetitions and a variety of activities. It is found to be unrelated either to chronological age or mental age, though normal and bright children most easily develop the concept.[8]

Although the process of blending is difficult for many children, its importance is stressed by reading specialists. Kottmeyer suggests that sound blending to unlock unfamiliar words is particularly useful for pupils who have difficulty in retaining a sight vocabulary.[9] Spache asserts that two fundamental phonic skills, namely blending and substitution, are often ignored. The child must learn to recognize a phonic element and after sounding it must blend it with the rest of

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[7] Ibid., p. 567.

[8] Albert J. Mazurkiewicz, "The Initial Teaching Alphabet (i/t/a)," The Disabled Reader ed. John Money. (Baltimore: The John Hopkins Press, 1966), pp. 173-174.

[9] William Kottmeyer, Teacher's Guide for Remedial Reading (St. Louis: Webster Publishing Co., 1959), p. 115.

the word.[10] Smith concludes that a great deal of phonic teaching ends with the development of visual and auditory discrimination and that two additional skills, blending and contextual application, should be developed. Blending, she adds, is a difficult process to teach and usually requires much practice.[11]

In summary, it appears that blending ability is a basic phonic skill, yet for many children it seems to be a difficult process to master. Certain reasons have been put forth for the failure in this area, but sufficient evidence is not presently available to determine the cause of this disability.

II. PURPOSE OF THE STUDY

Stated specifically, the general purpose of this investigation is to determine:

1. certain characteristics of grade two pupils which may be related to the ability to blend sounds auditorily, and
2. the significance of auditory blending as a skill in relation to reading achievement.

It is hoped that additional information related to auditory blending may be contributed which might be useful in reading instruction and in the diagnosis of reading disability.

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[10] George D. Spache, Reading in the Elementary School (Boston: Allyn and Bacon, Inc., 1964), p. 301.

[11] Nila Banton Smith, Reading Instruction for Today's Children (Toronto: Prentice Hall of Canada, Ltd., 1963), p. 201.

III. HYPOTHESES

In order to determine the characteristics which are related to the ability to blend sounds to reproduce words, and to investigate the importance of auditory blending as a skill in relation to reading and spelling achievement, the following hypotheses were formulated:

Hypothesis I

Children who have good auditory blending ability perform significantly better on reading and spelling achievement tests than children who have poor auditory blending ability.

Hypothesis II

Children who have good auditory blending ability perform significantly better on tests of aptitudes assumed to be related to auditory blending ability than children who have poor auditory blending ability.

Hypothesis III

There is a significant relationship between auditory blending ability and reading and spelling achievement, and between auditory blending ability and certain aptitudes and characteristics assumed to be related to auditory blending ability.

Hypothesis IV

Auditory blending ability is a significant predictor of reading and spelling achievement.

Null Hypotheses

The following null hypotheses corresponding to the research hypotheses were tested:

Hypothesis I

There is no significant difference between the mean scores of good blenders and the mean scores of poor blenders on:

a. The Gates Advanced A. W. R. Test

b. The Gates Advanced A. P. R. Test

c. Betts Sight Vocabulary Test

d. Schonell Graded Word Recognition Test

e. Pronunciation of Nonsense Words

f. Schonell Graded Spelling Test.

Hypothesis II

There is no significant difference between the mean scores of good blenders and the mean scores of poor blenders on:

a. Auditory Discrimination Tests

   i. Wepman Auditory Discrimination Test

   ii. Hearing Sounds in Words Test

   iii. Hearing Vowel Sounds in Words Test

   iv. Rhyming Test

b. Auditory Memory Span Tests

   i. Auditory Memory Span for Letters Test

   ii. Auditory Memory Span for Sounds Test

   iii. Auditory Memory Span for Rhythm Test

c. Laterality Test

Hypothesis III

There is no significant relationship between auditory blending ability and reading and spelling achievement, and between auditory blending ability and certain aptitudes and characteristics assumed to be related to auditory blending as in the following:

a. Gates Advanced A. W. R. Test
b. Gates Advanced A. P. R. Test
c. Betts Sight Vocabulary Test
d. Schonell Word Recognition
e. Pronunciation of Nonsense Words
f. Schonell Spelling Test
g. Wepman Auditory Discrimination Test
h. Hearing Sounds in Words Test
i. Hearing Vowel Sounds in Words Test
j. Rhyming Test
k. Auditory Memory Span for Letters Test
l. Auditory Memory Span for Sounds Test
m. Auditory Memory Span for Rhythm Test
n. Laterality Test
o. Chronological Age
p. Mental Age
q. I. Q.
r. Sex

Hypothesis IV

Auditory blending ability is not a significant predictor of reading and spelling achievement.

IV. ASSUMPTIONS

1. It was assumed that I. Q. scores as measured by the Thorndike Advanced Intelligence Tests are accurate indications of the pupils' mental abilities.
2. It was assumed that auditory blending ability is a phonic skill necessary in word attack and thus an important factor in learning to read.
3. It was assumed that the testing instruments selected for this investigation are valid and reliable.

V. DESIGN OF THE STUDY

The Sample

The Roswell-Chall Auditory Blending Test was administered in May, 1966 to 186 children who were in their second year of school in two suburban elementary schools in Edmonton. From this population a sample, divided into two groups, was identified: the "Good Blenders," twenty-five children who placed at the upper end of the test scores; and the "Poor Blenders," the twenty-five children who placed at the lower end of the test scores. An audiometer screening test was then administered to the poor blenders to ascertain the adequacy of their hearing acuity.

Procedure

A battery of tests selected to isolate certain characteristics assumed to be related to blending ability was administered individually

by the investigator during May and June, 1966. Information concerning chronological age, intelligence test scores, and reading test scores was obtained from the school records. The data obtained on the good blenders and the poor blenders were then recorded and processed at the Computing Centre at the University of Alberta. Finally, an analysis and interpretation of the results were made.

Analysis of Data

The following statistical procedures were carried out:

1. Differences between the means of scores of good blenders and poor blenders on the various tests were determined.
2. The 't' test was applied to determine the significance of differences in means of scores.
3. Intercorrelations between test scores on reading and spelling achievement and test scores on the characteristics related to auditory blending ability were computed.
4. To assess the contribution of auditory blending ability and its related aptitudes to reading and spelling achievement, the analysis of covariance contained within the multiple regression technique was employed.
5. The F ratio test was used to determine the significance of these contributing variables, thus indicating their importance to the study.

VI. DEFINITION OF TERMS

Phonics

Phonics as defined by Harris[12] is "the study of the speech equivalents of printed symbols and their use in pronouncing printed words."

Auditory Blending

Auditory blending refers to the ability to reproduce a word by the fusion of its component sounds.

Good Blenders

Good blenders refer to the twenty-five children who obtained scores of twenty-nine and thirty out of a possible score of thirty and therefore placed at the upper end of the distribution of scores on the *Roswell-Chall Auditory Blending Test*.

Poor Blenders

Poor blenders refer to the twenty-five children whose scores fell between nine and twenty-three and therefore placed at the lower end of the distribution of scores on the *Roswell-Chall Auditory Blending Test*.

Auditory Discrimination

Auditory discrimination, as defined by Wepman, is "the capacity to distinguish between phonemes, or individual sounds used in speech."[13]

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[12] Harris, *op. cit.*, p. 324.

[13] Joseph M. Wepman, "Auditory Discrimination, Speech and Reading," *The Elementary School Journal*, LX (March, 1960), p. 325.

Auditory Memory Span

Auditory memory span refers to the ability of immediate recall of related or unrelated elements.

VII. LIMITATIONS OF THE STUDY

1. The small size of the sample, and the fact that this sample was comprised of good blenders and poor blenders only, must be considered as an important factor in evaluating the findings, implications, and conclusions of the study.
2. Certain tests used in this study were devised by the investigator herself, and, in some instances were adaptations of other tests. No attempt was made to establish the reliability and validity of these tests.
3. Some tests were of somewhat questionable validity for the purpose for which they were used; for example, the *Rhyming Test* is not a test of rhyming ability only, since the factor of retrieval precludes the ability to rhyme. The *Auditory Memory Span for Rhythm Test* does not involve the rhythm of speech sounds but rather the rhythm of a tapped pattern of staccato-like sounds. The scores of the majority of poor blenders exceed the "inferior range" as determined by the *Roswell-Chall Auditory Blending Test*.

VIII. THE NEED FOR THIS STUDY

Smith suggests that blending as a phonic skill is a difficult process to teach.[14] The reason that blending may be a difficult

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[14] Smith, *op. cit.*, p. 201.

skill to teach and to master is the fact that it has not been determined just what constitutes this ability to synthesize sounds. It is known that children with superior intelligence may have extreme difficulty with blending sounds and with word recognition. Hence, additional objective data are required to discover certain characteristics which may be related to the ability to blend sounds and to investigate the contribution of this skill to reading achievement.

If auditory blending ability bears a relationship to reading achievement, then as suggested by Smith and Spache, more emphasis should be put on teaching this skill. If auditory blending ability is related to reading achievement, then it might also be considered as another measure of reading readiness. Therefore, an attempt should be made in Kindergarten and in Grade I to identify children with a deficiency in this skill. It is hoped that a knowledge of the significance of auditory blending ability and of the characteristics related to this skill will help to improve reading instruction.

IX. ORGANIZATION OF THE REPORT

The rest of the thesis is organized as follows:

Chapter II: The theoretical background for the study.

Chapter III: A review of the related literature pertaining to the study.

Chapter IV: A description of the method employed for the selection of the sample, the testing instruments, the experimental techniques and the statistical treatment of the data.

Chapter V: The results and interpretation of the statistical analysis.

Chapter VI: The summary, conclusions based on the findings, the implications for teaching and further research.

CHAPTER II

THE BACKGROUND OF THE STUDY

A prerequisite to the development of the child's reading potential and to the analysis and diagnosis of his reading problem would appear to be an understanding of the processes involved in the reading act. It is an accepted fact that reading is a highly skilled activity which necessitates numerous physical, mental, and intellectual processes. Consequently, the reading process has been interpreted variously as a perceptual act, a cognitive activity, a series of stages to be mastered, and the development of certain basic skills. However, for the purposes of this investigation an integrated approach is being adopted in the discussion which centres on the perceptual process in reading behaviour and on the role of auditory blending in that process.

I. WORD PERCEPTION IN THE READING PROCESS

Since reading ordinarily requires proper functioning of the eyes, it is often described as a visual act. When one is engaged in the act of reading, the characteristic stimuli of the graphic symbols are differentiated and become focused as an image on the retina. This image is then relayed through the optic nerves to the cerebral centre of the brain where it is translated into a meaningful unit or message. In terms of visual activity, the eyes move along the printed line from left to right, making short stops or fixations, the length of the stops

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depending upon the maturity of the reader. During these fixations reading actually occurs. It is thought that in this interval visual symbols are recognized, identified, and categorized. These operations, in turn, initiate meaning and perception of the printed word.

It is assumed that the mature reader performs these activities automatically, but for the beginning reader these processes may not occur simultaneously and therefore require cognitive activity. The young child, as he acquires certain skills which aid him in word perception, must rely on his memory which is dependent upon associations in his past experiences.

Although there are many theories of perception, it is assumed that the child responds to the Gestalt or to the whole word in the act of reading. However, it has been determined that certain distinguishing features of the word aid the child in visual perception. The initial or final letter, the length or shape of the word, or the pattern within the word are all important visual clues for the beginning reader. Thus, the child in all probability uses the "whole" and the "parts" within the whole to aid him during the initial stages of word identification. Vernon would support this assumption since she states:

> Perhaps length, outline, and the presence of certain particular letters are all utilized from time to time, sometimes in combination, sometimes one aspect rather than the others.[1]

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[1] M. D. Vernon, "The Perceptual Process in Reading," The Reading Teacher, XIII (October, 1959), p. 5.

Goins found that good readers at the end of the first grade were those children who were able to retain in mind a total configuration at the same time that they attended to the parts of the whole.[2] De Hirsch lends support to Goins' findings when she points out that:

> ...in normal reading analysis of the whole and integration of parts goes forward simultaneously and the combination of both makes for good reading.[3]

Although the child in the initial stages of learning to read responds to the "whole word" if it possesses meaning for him, this response cannot be termed reading in its true sense. It is possible for the child to retain in his mind only a limited number of graphic forms for recall. Since words are composed of graphic symbols that represent sounds in our spoken language, it seems logical to assume that it is only when the child can interpret these symbols as meaningful sound structures that he is actually engaged in the process of reading. Vernon observes that the whole word method which relies on rote memory alone does not constitute real reading. She suggests that certain techniques must be taught the child whereby he learns to identify words in a systematic manner to enable him to become an independent reader.[4]

Two eminent reading authorities, Gray and Russell, interpret word perception, also, as a two-stage process. Gray envisages the

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[2] Jean Turner Goins, "Visual and Auditory Perception in Reading," <u>The Reading Teacher</u>, XIII (October, 1959), p. 11.

[3] Katrina de Hirsch, "Concepts Related to Normal Reading Processes and Their Application to Reading Pathology," <u>The Journal of Genetic Psychology</u>, CII (March, 1963), p. 281.

[4] Vernon, <u>loc</u>. <u>cit</u>.

first stage as a process involving certain tasks in acquiring a sight vocabulary. The second stage involves independent perception of words which includes two major aspects of word analysis, namely, "phonetic" and "structural" analysis.[5] Russell, another reading authority, recognizes two similar steps in word recognition. The first step relates to the observation of the whole word or phrase in terms of shape or configuration. Additional clues such as length, the characteristic features at the beginning, end, or middle of the word, and context help to determine word perception. When these clues fail in word identification, then at the second step the reader resorts to some form of word analysis.[6] Thus, it appears that actual word perception required for successful reading performance is a two-stage process. The first stage, centred on the simple discrimination and recognition of the word, precedes the stage of independent word perception which involves the use of phonic and structural analysis techniques.

Another point of view pertaining to the reading process is presented by Wepman. He hypothesizes that

> ...some children acquire reading solely as a visual skill, while others do so through a combined phonetic-phonemic-visual integration.[7]

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[5] William S. Gray, "The Major Aspects of Reading," Sequential Development of Reading Abilities, Supplementary Educational Monograph No. 90, ed. Helen M. Robinson. (University of Chicago, Illinois Press, 1960), pp. 9-13.

[6] David H. Russell, Children Learn to Read (Toronto: Blaisdell Publishing Company, 1961), p. 105.

[7] Joseph M. Wepman, "Dyslexia: Its Relationship to Language Acquisition and Concept Formation," Reading Disability, Progress and Research Needs in Dyslexia, ed. John Money. (Baltimore: The John Hopkins Press, 1962), p. 183.

The implication drawn from this thesis is that there are individual differences in modalities of learning, thus resulting in children being classified as the "visile" type, those who learn best through a visual approach, or the "audile" type, those who learn best through a listening approach.

In contrast to this concept of the learner, Birch proposes the concept of stages of perceptual development. The first level of perceptual discrimination is followed by a level of perceptual analysis and a final level of perceptual synthesis. At the perceptual analysis level the individual has the capacity to separate out the units of a Gestalt and at the synthetic perceptual level he is capable of combining these units into a whole.[8] Benger has postulated that as with visual perception, there might be levels of auditory analysis and synthesis in auditory perception.[9] De Hirsch notes also that maturation of the child determines which aspect of the Gestalt can be handled when she states:

> Thus in the final analysis there is no dichotomy between part and whole learning, since both are inherent in the reading process--it is rather a matter of which size configuration the child is ready for.[10]

In conclusion, therefore, it appears that the independent level of word perception is that stage of maturity that the child has achieved when he has the capacity to analyze and synthesize the structures of the whole.

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[8] Birch, in Money, _ibid_., pp. 168-169.

[9] Kathlyn Benger, _A Study of the Relationships Between Perception, Personality, Intelligence and Grade One Reading Achievement_ (unpublished Master's thesis, The University of Alberta, Edmonton, 1966), pp. 35-36.

[10] De Hirsch, _op. cit_., pp. 284-285.

II. AUDITORY BLENDING IN WORD PERCEPTION

Although word perception as a highly developed skill appears to be basically a visual skill, it cannot be assumed that this is necessarily the case. The mature reader has the capacity to analyze rapidly or to separate the word into smaller units, and then to reassemble these units into the whole to aid him in word identification. Since the graphic symbols represent sounds in our spoken language, it is postulated that this rapid visual synthesis of word elements is dependent upon automatic auditory language structures which have been registered as neural mechanisms in the brain. Furthermore, this simultaneous integration of visual and auditory elements has been achieved in much the same way in which the child learned to speak. In short, auditory blending is an integral part of language learning and of word perception.

If one explores the processes through which the child develops language ability, it is learned that his first babblings consist of various phonemes. As these phonemes are produced in succession and appear to have meaning for people near him, the child is rewarded. Thus, as he repeatedly monitors his own babblings and imitates sounds around him, the child learns to speak. It is contended that this process of uttering and combining syllables is dependent upon the auditory blending of sounds.

By the same analogy, the child learns to synthesize words "visually" through repeated "aural-oral" experiences. He gradually becomes aware that the printed word which represents the spoken word

is a series of sounds which combined make up a conventional sound pattern that corresponds to letter symbols within the word perceived. Thus, through repetition, integrations occur between the visual graphic stimuli and their corresponding sound stimuli. These integrations eventually become automatic and spontaneous expressions. Auditory blending which is basically a neurological process thus supports and facilitates visual blending in the process of word perception.

To understand the processes involved in auditory blending, certain knowledge of the neurological activities involved is necessary. Hebb's theory of cell assemblies, whereby groups of cells in interrelated clusters react or fire in certain sequences, provides one of the most widely accepted neurological explanations. It is suggested that cell assemblies, that is, mediating processes, may contain traces of various types of information related to the recognition and comprehension of printed symbols, such as the memory for shapes, sounds, syllables, and meanings of letters and words.[11] In recent years certain psychologists, in attempts to interpret the language process or to diagnose difficulties in this area, have developed models related to Hebb's theory.

Osgood has postulated a model related to the higher mental processes, which involves language behaviour. Two stages in this model provide for a distinction between the decoding process, whereby messages are received and interpreted, and the encoding process, whereby messages are expressed. These two stages are further organized into

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[11] Donald O. Hebb, A Textbook of Psychology (Philadelphia: W. B. Saunders Co., 1958), pp. 100-108.

three levels of behaviour:

> (1) a projection level of organization, which relates both receptor and muscle events to the brain via "wire-in" neural mechanism; (2) an integration level which organizes and sequences both incoming and outgoing events, and (3) a representation or cognitive level, which is at once the termination of decoding operations and the initiation of encoding operations.[12]

If this model is interpreted in terms of word perception at the initial stages of reading, it appears that at the projection level the visual stimuli of graphic symbols are relayed to the brain, but learning does not occur. At the next stage, the integration level, discrimination of the graphic symbols is followed by their translation to their oral counterparts. These sounds or phonemes are then organized, sequenced and finally expressed vocally or subvocally in the encoding process. At the final stage, the representation level, the word is given meaning and is responded to by the individual. Thus, in Osgood's model, auditory blending occurs at the integration level where sounds are sequenced and fused to initiate the expression of a word.

Smith and Carrigan have proposed a chemical model related to the blending of phonemes. They theorize that the inability to blend phonemes is caused by an imbalance of hormones which prevents the transmission of neural impulses from one neuron to another.[13]

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[12] Charles E. Osgood, "A Behavioristic Analysis of Perception and Language as Cognitive Phenomena," The Cognitive Processes: Readings, ed. Robert J. C. Harper et al. (Englewood Cliffs: Prentice-Hall, Inc., 1964), p. 185.

[13] Donald E. P. Smith and Patricia M. Carrigan, The Nature of Reading Disability (New York: Harcourt, Brace and World, Inc., 1959), cited by Emerald V. Dechant, Improving the Teaching of Reading (Englewood Cliffs: Prentice Hall, Inc., 1964), pp. 491-492.

On the basis of these hypothetical neurological and psycholinguistic models, auditory blending in behavioural terms of the reading act may be considered to be an internalized synthetic process whereby sounds translated from graphic symbols are sequenced and held in memory while traces from the first sound reverberate as the succeeding sounds are being fused with it to form a recognizable sound pattern. This pattern is given expression in the vocalization or subvocalization of the word.

Further evidence that a process of internalization is involved in word perception is revealed by the linguist's interpretation of reading behaviour. Strickland has attempted to clarify their interpretation of the reading process when she points out that:

> The linguist conceives the reading act as that of turning the stimulus of the graphic shapes on a surface back into speech. The shapes represent speech; meaning is not found in the marks but in the speech which the marks represent. In the eyes of the linguist, a child can read when he can recognize symbol-sound correspondence to the point that he can respond to the marks with appropriate speech.[14]

Learning to read therefore, as interpreted by the linguists, consists in developing automatic responses to graphic shapes or patterns. This process is achieved by a method of contrasts, that is, the presentation of minimal pairs, for example, cat-rat, cat-pat.

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[14] Ruth G. Strickland, "The Contributions of Structural Linguistics to the Teaching of Reading, Writing, and Grammar in the Elementary School," Bulletin of the School of Education (Indiana University, Vol. 40, No. 1, 1964), p. 10, cited by Nila Banton Smith, American Reading Instruction (Newark: International Reading Association, 1965), p. 385.

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Hence, it is assumed that although these linguists do not refer to a blending process, the ability to distinguish and hear contrasts in minimal pairs implies a form of internalization or reconstruction, which presumably must involve the auditory blending of phonemes. In support of this assumption, reference is made to Bloomfield, who notes that the child does his first reading aloud, but that the literate adult has reduced these speech-movements to a form of internal speech.

> That is, he has developed a system of internal substitute movements which serve him, for private purposes, such as thinking and silent reading, in place of audible speech-sounds.[15]

In attempting to ascertain the role of auditory blending in word perception, it must be pointed out that this process is not a cognitive activity in the rapid perception of words. However, it is postulated that auditory blending is involved in the formation of integrations of visual and auditory stimuli and is therefore an integral part of the process of internalization or reconstruction that facilitates word perception in the process of reading.

III. THE SIGNIFICANCE OF AUDITORY BLENDING

In the preceding discussion it has been hypothesized that auditory blending, which is a phonic skill, is an essential aspect of word perception. Many reading authorities and those who are authors of the authorized reading series in Alberta, while defining reading behaviour as a series of skills to be developed, are generally agreed

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[15] Leonard Bloomfield, "Linguistics and Reading," The Elementary English Review, XIX (May, 1942), p. 183.

that phonics analysis is one of the useful techniques employed in word identification. Each advocates the use of consonant substitution whereby the initial or final consonant is associated with a consonant sound and is blended with the remaining sounds or phonogram within the word. Gray states:

> One of the values of abundant practice in consonant substitution is that of the ability to blend sound rapidly and smoothly into words. This blending of a consonant sound with the remaining sounds provides readiness for the next level of growth in phonetic analysis--identifying a vowel sound in a one syllable word and blending this sound with consonant sounds to make a meaningful word in context.[16]

Russell suggests in his outline of a developmental program of word-analysis activities that practice in blending initial consonants with known parts of words should be initiated at the primer level and continued through to the first reader level. At the second reader level the child should be developing independence in using word-recognition techniques in attacking new words by blending with initial consonants as well as using the ending and medial consonants.[17]

McKee observes that:

> The pupil finds letters and groups of letters, sometimes called phonograms or phonetic elements, within the form of the word and thinks or makes and blends the sounds of these letters and groups of letters to help him get the pronunciation of the word.[18]

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[16] William S. Gray, On Their Own in Reading (Chicago: Scott, Foresman and Company, 1960), p. 42.

[17] Russell, op. cit., p. 315.

[18] Paul McKee, The Teaching of Reading in the Elementary School (Boston: Houghton Mifflin Company, 1948), p. 238.

Blending then, as interpreted by these specialists, is a technique to aid in word perception. This technique consists of fusing the initial or ending consonants with the remaining part of the word, the phonogram or phonic element, to assist in the pronunciation of the unfamiliar word.

Further value of auditory blending which initiates the pronunciation of the word is seen in the fact that it acts as a reinforcing instrument in word retention, particularly for those with poor visual memory. In addition, since auditory blending relates the visual to the auditory it thus facilitates inner speech phenomena, a feature which seems to accompany the thinking process.[19] Auditory blending is helpful also not only in the recognition of short easier words, but aids in the pronunciation of long and complicated word structures. In conclusion, it can be assumed that auditory blending is a valuable and significant skill. It is well known that a deficiency in this skill is a characteristic of many disabled readers.

IV. SUMMARY AND RATIONALE

In this chapter a background for the study has been provided. An attempt was made to analyze the reading process in terms of word perception and to ascertain the function of auditory blending in word identification. By discussing and defining auditory blending in behavioural terms, the commonality of this process in the various interpretations of the reading process was demonstrated. Its value as

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[19] Emerald V. Dechant, op. cit., p. 92.

a phonic skill has been acknowledged by leading reading authorities and likewise a deficiency in this skill has been observed in many dyslexic children. Thus, an investigation into the nature of this skill appears to be well justified.

The central issue explored by this investigation is that auditory blending is a valuable technique in the reading process and that this technique is related to certain characteristics or traits which may contribute to a proficiency in this auditory skill. Through the definition of auditory blending in behavioural terms, these related abilities were determined. Therefore, it should be possible to demonstrate that good auditory blenders possess certain abilities, which in turn are reflected in superior reading achievement. Conversely, it should be possible to show that poor auditory blenders are deficient in these related abilities and therefore will perform less ably on tests of reading achievement.

CHAPTER III

A REVIEW OF RELATED RESEARCH

The importance of various auditory abilities has been well documented by most reading authorities. However, these abilities have not always been clearly differentiated and frequently they have been considered as composite factors of auditory perception or auditory discrimination in the studies made in this area. Therefore, the review of literature will deal first with related auditory abilities which include auditory blending. The next section of this chapter will deal with auditory blending as an isolated factor in auditory perception.

I. A REVIEW OF THE LITERATURE PERTAINING TO RELATED AUDITORY ABILITIES

One of the earlier studies in this area was made by Bond, who investigated the auditory disabilities of sixty-four "poor" readers in grades two and three. This group of "poor" readers was matched with a group of "good" readers on the basis of sex, age, intelligence and grade level. Each group was further reclassified into two groups with respect to the method of instruction, the "look-and-say" group and the "phonetic" group. Tests measuring the auditory aptitudes of acuity, memory of rhythm, perception techniques, blending, discrimination, and memory of digits were administered. The results of Bond's study showed that significant differences exist between "good" and "poor" readers in auditory blending and in auditory perception techniques. Differences were also found between the experimental and control

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groups in memory of rhythm, auditory discrimination, and memory of digits. In addition, the findings revealed that differences between "good" and "poor" readers who were taught by a "phonetic" method were greater than the differences between "good" and "poor" readers taught by the "look-and-say" method in measures of auditory abilities. This suggests, according to Bond, that certain deficiencies in auditory perception may be related to a particular teaching method. Therefore, these deficiencies cannot be considered to be innate but must be, to some degree, acquired, except perhaps in some cases of severe disability.[1]

Ewers sought to relate reading disabilities to auditory defects by studying 140 high school students. She administered both silent and oral reading tests as well as forty-three tests of auditory functioning which measured both language and musical aspects. Her findings showed that syllable blending, the ability to pronounce the word after the syllables have been sounded out in sequence, was correlated strongly with silent and oral reading. Letter blending, the ability to fuse given sounds to form a word, was correlated with silent and oral reading to a lesser degree. She found, also, with only a few exceptions, that correlations between auditory discrimination tests and silent and oral reading were low.[2]

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[1] Guy L. Bond, _The Auditory and Speech Characteristics of Poor Readers_ (New York: Teachers' College, Columbia University, 1935), pp. 1-45.

[2] Dorothy W. F. Ewers, "Relations Between Auditory Abilities and Reading Abilities: A Problem in Psychometrics," _Journal of Experimental Education_, XVIII (March, 1950), pp. 239-262.

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Reynolds studied certain measures of auditory characteristics for possible relationships with certain reading measures. His sample consisted of 188 fourth grade pupils. No attempt was made to separate "good" and "poor" readers. Pertinent auditory aptitudes measured were word discrimination and oral (auditory) blending. Word discrimination ability was tested by a fifty-item test of paired words either the same or very similar. Oral blending ability was assessed in individual testing where the tester presented the sound values for word elements at one-second intervals and the pupil attempted to blend these sounds to make a complete word. From an analysis of test results, Reynolds found that auditory blending was unrelated to general ability, except in one school where this test was related to word recognition. Auditory discrimination showed a somewhat higher relationship with all aspects of reading achievement. In two out of four schools, significant relationships were found between general reading achievement and word discrimination ability.[3]

A series of studies related to reading readiness was initiated by Gates in 1933. The study of 1937-1938 is reported here. Several tests of auditory perception, including an auditory blending test, were administered. In the auditory blending test the sounds, one at a time, were given with a slight pause between sounds. The child was required to give the word that was sounded out. A rhyming test was included also. Classes in nine different schools were divided into five groups

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[3] Maynard Clinton Reynolds, "A Study of the Relationships Between Auditory Characteristics and Specific Silent Reading Abilities," Journal of Educational Research, XLVI (February, 1953), pp. 439-449.

according to the type of program used to teach beginning reading. These programs were classified as phonics, look-and-say, experience, basal reader, and combination. The findings based on statistical intercorrelations revealed that in the groups where the look-and-say method prevailed, the rhyming and blending tests gave lower predictions than in the groups where phonics instruction was used in conjunction with the basal reader approach.[4]

A further evaluation of reading readiness was made in 1938-1939. In the previous studies where several tests dealing with auditory perception were administered, it was found that similar results were obtained. Therefore, in this study, only the tests of rhyming and auditory blending from the auditory perception test battery were retained. In the auditory blending test, pictures were shown and the names of the objects given. Then, one of these names was sounded out, with short pauses between, and the child was asked to identify the corresponding picture. Pictures were used, too, in the test of rhyming. Here the child was required to match a given word, for example, "pup," with the picture of a cup. The results from these tests failed to identify pupils who were failing or succeeding in reading. It was felt that perhaps the tests were too short to give reliable results.[5]

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[4] Arthur I. Gates, "An Experimental Evaluation of Reading Readiness," Elementary School Journal, XXXIX (March, 1939), pp. 497-508.

[5] Arthur I. Gates, "A Further Evaluation of Reading-Readiness Tests," Elementary School Journal, XL (April, 1940), pp. 577-591.

Another study which considered the auditory aspects of reading readiness was made by Reid, who dealt with the aptitude for auditory discrimination as a composite of several abilities. She tested the auditory abilities of 118 children during their first year of school to determine how these abilities were related to reading achievement at the conclusion of the first grade. The mean chronological age of the entire sample was six years and two months, while the mean mental age was seven years. The mean I. Q. for the sample was 114.7. Several tests which measure auditory aptitudes were administered. The _Auditory Fusion Test_ taken from _Betts Ready to Read Tests_ was given. In this test eighteen words divided into phonemes were presented to the child orally and he was asked to give the word that the fusion of these sounds would make, for example, ch - o - p. In addition, tests which measured auditory discrimination were given. Reid found that the relationship between auditory fusion of sounds or auditory blending became significant only after reading had been taught. Her findings showed that auditory discrimination of sounds in words was significantly correlated with oral reading and with word recognition, and showed significant growth during the first year of school. Girls apparently have an advantage over boys in beginning reading because of their superiority in certain auditory skills.[6]

Dykstra, also, conducted a study in which auditory discrimination was considered to be a measure of several abilities. The purpose of

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[6] Ruth Reid, "Auditory Aspects of Reading Readiness," (unpublished Master's thesis, The University of Alberta, Edmonton, 1962).

the study was similar also to that of Reid's, in that Dykstra sought to determine the relationship which exists between certain measures of auditory discrimination at the beginning of the first grade and achievement in reading at the end of the first grade. His sample consisted of 632 pupils from eight randomly selected schools. Several tests of auditory discrimination were administered, which included tests of auditory blending, discrimination of beginning and ending sounds in words, and rhyming. Using the multiple regression technique, Dykstra found that auditory blending, discrimination of beginning sounds, and chronological age were not significantly related to reading achievement. However, intelligence and five other measures of auditory aptitudes were found to be significantly related to reading achievement. His findings revealed, also, that girls were significantly superior in three measures of auditory discrimination while boys failed to hold the advantage in any.[7]

II. A REVIEW OF THE LITERATURE PERTAINING TO AUDITORY BLENDING

Monroe extended her original study in order to assess the ability in blending of sounds of 126 control children (101 school children of the original group and twenty-five first grade children) and 269 reading-defect cases. A test of fifteen words in which each child was obliged to combine sounds in word-building, as in "sh - oe," was administered. This study revealed that some reading-defect

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[7] Robert Dykstra, "Auditory Discrimination Abilities and Beginning Reading Achievement," Reading Research Quarterly, I (Spring, 1966), pp. 5-34.

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children had extreme difficulty with the test and that the group as a whole made a lower mean score than the controls. From the bimodal distribution of scores of the reading-defect cases, Monroe concluded that there were two types of children: some are handicapped in auditory perception of sound patterns; and others, while not so handicapped, probably have other factors contributing to their defect.[8]

Vernon reported also that her retarded readers lacked ability to blend sounds correctly into words. She found that nine children, aged seven to eight years and who were retarded by one and a half years, could recognize and match 49 per cent of a set of letter combinations (la, zo, ed) and give the sounds of 51 per cent of the single letters presented to them. However, when the letters were arranged to make simple three and four-letter words, they could blend these letters and give the whole word in only 35 per cent of the cases.[9]

Hester, too, by examining the records of 194 children, studied the nature of their reading difficulties. Scores on the _Durrell Analysis of Reading Difficulties_ revealed that sixty-four out of 194 pupils scored at the third grade level or above on both the word-recognition and the word-analysis tests and were therefore excluded from the phonic test. Eighteen children had no difficulty with the letter names, sounds, or blends. Thus, there remained 112 children who had difficulty with letters, sounds, and blends, and therefore

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[8] Marion Monroe, _Children Who Cannot Read_ (Chicago: The University of Chicago Press, 1939), pp. 96-97.

[9] M. D. Vernon, _Backwardness in Reading_ (Cambridge, At The University Press, 1958), pp. 58-60.

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lacked adequate knowledge of phonics necessary for independent word attack. Examination of the results showed that blending was a more difficult process than naming letters, since the errors were more evenly distributed over all the blends, while in the case of letter sounds, errors were centred on a few letters. From this evidence, Hester concluded that since blending is a more difficult process, it needs to be taught specifically to reduce reading difficulties. Further examination revealed that there is a rapid increase in phonetic difficulties during the age levels corresponding to the second and third grades, with the maximum being reached at the fourth and fifth grade levels, after which there appears to be a gradual tapering off. Hester suggests that this finding implies that deficiencies in phonetic ability are not dealt with in the upper elementary grades.[10]

Mulder and Curtin's findings lend support to those of Hester's. Sixty-three fourth grade pupils were tested in order to determine their ability to synthesize phonetic elements into words. A tape recording of seventy-eight one-syllable nouns was made. Each of the words was broken into phonetic elements by a male speaker at the rate of one per second. To minimize the importance of reading, answer sheets which contained three pictures for each test item were provided for each pupil. The three words accompanying the pictures had a common sound element; for example, the test word tie was accompanied by pictures of a pie, a tie, and number "5." Each pupil was asked

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[10] Kathleen B. Hester, "A Study of Phonetic Difficulties in Reading," The Elementary School Journal, XLIII (November, 1942), pp. 171-173.

to identify the word he heard by checking the right picture. From their test results, Mulder and Curtin found a positive relationship between silent reading ability and the ability to synthesize elements in words presented orally. They concluded that the inability to identify stimulus words was the result either of deficiencies in the discrimination of speech sounds, or lack of sound-symbol association.[11]

A longitudinal study was conducted by Chall, Roswell, and Blumenthal after they noted that children with severe reading disability had difficulty in learning phonics, particularly in blending and synthesizing sounds. The purpose of their study was to explore the relationship between auditory blending ability, reading achievement, and I. Q. Their subjects were sixty-two Negro children in two first grade classes who had a mean I. Q. of 106. They were given a thirty-item test of auditory blending constructed by the authors. In this test, the component parts of the word were sounded by the examiner at about one-half second intervals, and the child was asked to identify the word he heard. Examples are given from the three parts of the test.

Part I	Part II	Part III
i - f	st - ep	m - a - p
h - e	c - all	r - u - g

The Metropolitan Primary II and Metropolitan Elementary tests were administered in grades three and four, from which silent reading test

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[11] Robert L. Mulder and James Curtin, "Vocal Phonic Ability and Silent Reading Achievement: A First Report," The Elementary School Journal, LVI (November, 1955), pp. 121-123.

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scores were derived. Pertinent findings from this study showed that there was an insignificant correlation between auditory blending in grade one and I. Q. but that there was a substantial relationship between auditory blending ability in grade one and silent reading in grade three. A higher relationship existed between auditory blending and silent reading when intelligence was held constant. Further findings from additional testing revealed that auditory blending ability, whether tested in grades one, two, three, or four, was positively correlated with oral and silent reading ability. It was more highly correlated with oral than with silent reading and most highly related to achievement in word analysis skills. Children with I. Q.'s below one hundred were almost always among those with poor blending ability in grades one, two, three, and four. However, a substantial number of those with higher I. Q.'s seemed to have difficulty in auditory blending. Thus, Chall, Roswell, and Blumenthal hypothesize that poor blending ability may be a sign of neurophysiological defect or a lag in development.[12]

The above hypothesis is supported by Huset. She compared two matched groups of grade four and five children who had a mean age of ten and one-half years and who ranged average to superior in intelligence. All children had severe reading disabilities, but one group had adequate blending ability, while the other group had inferior blending ability as determined by the Roswell-Chall Auditory Blending Test. The

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[12] Jeanne Chall, Florence G. Roswell, and Susan Hahn Blumenthal, "Auditory Blending Ability: A Factor in Success in Beginning Reading," The Reading Teacher, XVII (November, 1963), pp. 113-118.

results of the comparisons showed that on tests involving analytic-synthetic ability, perceptual and motor skills, children with inadequate blending ability performed less well. From her findings, Huset concluded that children who were severely disabled in reading and auditory blending were more likely to have a neurological involvement than children who had a severe reading disability without blending difficulty. She found that children who were deficient in blending ability had difficulty in the integration of both verbal and non-verbal material. Huset claims that this problem is manifested by difficulties in figure-ground discrimination, and, at higher levels, a poor ability to reason about abstract relations. However, good auditory ability in cases of reading disability does not necessarily indicate freedom from neurological involvement. It may accompany minimal brain damage or difficulties in visual-motor functioning.[13]

A more recent study on auditory blending was made by Hardy, who conducted an investigation in London Public Schools. Two groups, with forty in each, were selected from approximately 300 grade four students who were considered to have disabilities in reading. These groups were matched on the basis of intelligence, chronological age, sex, and silent reading ability. To determine whether it is possible to improve ability in auditory blending by means of direct instruction, a comparison was made of an experimental group from two classrooms and a control group composed of children from eight different classrooms.

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[13] Martha K. Huset, "Relationship Between Difficulty in Auditory Blending and Some Diagnostic Indicators of Organicity in Children of Average or Superior Intelligence with Severe Reading Disability," (unpublished Master's thesis, The School of Education, The City College of New York, New York, 1961).

A set of exercises in auditory blending was prepared by the examiner and used by the teachers of pupils in the experimental group over a five-month period. A well-balanced language program and a combination visual, auditory, and tactile spelling program was given. The results of this study showed that gains made by the experimental group in oral reading and in auditory blending, as measured by the _Roswell-Chall Auditory Blending Test_, were significantly greater than those made by the control group. Gains made by the experimental groups in silent reading and spelling were not significantly greater than those made by the control group.[14]

III. SUMMARY OF RELATED RESEARCH

An analysis of the literature reveals that several investigators have considered auditory discrimination as a composite of several auditory abilities, including that of blending. Yet, a few investigators have dealt with blending ability as a unique skill apart from other auditory abilities.

Results of the findings of the various studies are conflicting in many instances. Reid found that auditory fusion of sounds into words became significant after reading had been taught, and Bond found that all of the test scores which measured auditory discrimination ability were significantly related to reading achievement. Bond also found, as did Gates, that skill in auditory perception appeared to be

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[14] Madeline I. Hardy, "Auditory Blending as a Factor in the Reading and Spelling Achievement of Grade Four Pupils with Reading Disabilities," (unpublished Master's thesis, University of Toronto, Toronto, 1965).

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related to the teaching method employed. Reynolds found that auditory blending was unrelated to general ability except in one school where it was related to word recognition. Dykstra, too, found that auditory blending ability was not related to reading achievement at the end of the first grade. In contrast, Ewers found that, at the high school level, syllable blending and letter blending were correlated with silent and oral reading to a higher degree than was auditory discrimination. The investigators who studied auditory blending apart from auditory discrimination found generally that it was significantly related to reading. However, Chall, Roswell, and Blumenthal, in their study, and Hardy, in a separate study, found that auditory blending was more closely correlated with oral reading than with silent reading.

There were references made to inadequacies of testing measures for auditory abilities, and this may have been a factor in the discrepancies of auditory abilities. Several types of tests were used and some of these were devised by investigators themselves, and, in some instances, adaptations of certain tests were used. Types of studies varied, too. Some studies were longitudinal in nature, while in others, relationships were developed simultaneously.

It is noted also that the type of statistical analysis involved contributed to the inconsistencies in the findings. In those studies where the findings were based on simple correlations, auditory blending tended generally to be significantly related to reading achievement. By contrast, when the statistical technique of multiple regression was employed, auditory blending ability failed to reach significance as a predictor of reading achievement.

Although this review and brief assessment of the related literature on auditory blending ability indicate there are some inconsistencies, some findings merit further consideration. The fact that Chall found a substantial number of children with higher I. Q.'s who had difficulty in blending lends support to the hypothesis that a problem does exist in this area. For those children who are proficient in blending it can be assumed that they have adequate ability in the discrimination of sounds and related auditory abilities, but in the cases of children who are inferior in blending abilities it appears to be a matter of speculation. In an effort to provide information that may assist in this problem, this study proceeded to determine certain aptitudes and abilities which might be related to auditory blending ability and to determine the role of blending ability in reading and spelling achievement.

CHAPTER IV

THE EXPERIMENTAL DESIGN

This chapter consists of four sections. In the first section an account is given of the sample used in this study. A brief outline of the areas and aptitudes tested and the tests administered is given in the second section. The third section deals with a description and purpose of the tests used in gathering the data. The treatment of the data is discussed in the fourth section.

I. THE SAMPLE

Selection

The sample was selected from 186 children who were completing their second year in school in June, 1966. The schools attended by these children were in two neighbouring suburban districts of average and low cost housing in Edmonton, Alberta. From this group of 99 boys and 87 girls, two groups, the good blenders, and the poor blenders, were determined. The good blenders were those twenty-five children who placed at the upper end of the Roswell-Chall Auditory Blending Test scores, while the poor blenders were the twenty-five children who placed at the lower end of the Roswell-Chall Auditory Blending Test scores.

In order to determine that poor blending ability was not the result of deficient auditory acuity, a screening test was administered by means of the Maico Audiometer. This instrument provides for measurement over the range of frequencies ordinarily covered by oral speech.

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To determine hearing loss, measurements are compared with the normal rating which is a zero decibel loss. According to Bond and Tinker, a loss of ten decibels or more may be used as a practical standard.[1] A record of each child's performance on this test was recorded on an individual card provided by the Maico company. As a result of this screening test, two children from the poor blenders were found to have a hearing deficiency and were excluded from the original sample. The same procedures were applied to select replacements.

Children with speech impairment came under scrutiny. However, the examiner, after consultation with classroom teachers, decided to eliminate only one such child from the poor blending group.

Age and Intelligence

The mean chronological age of the good blenders was 95.80 months, and the mean chronological age of the poor blenders was 96.24 months at the time of testing.

Information on intelligence was obtained from the school record cards. Scores on group intelligence tests were used as a measure of intelligence. All children in the sample, with the exception of two, had been tested with the *Lorge Thorndike Intelligence Test* (*Level I*, *Form A*) in grade one during the month of November in 1964. This test, which is entirely non-verbal, is, according to Freeman, "among the best group tests available, from the point of view of the psychological constructs upon which it is based and that of statistical standardiza-

[1] Bond and Tinker, *op. cit.*, p. 95.

tion."[2] On the basis of these test results, the mean I. Q. score for the good blenders was 110.52 and the mean I. Q. score for the poor blenders was 102.36.

II. AREAS AND APTITUDES MEASURED

Several aptitudes and areas of achievement were measured and the relationship between blending ability and performance on these aptitude and achievement tests was determined. The tests administered are shown in Table I.

III. TESTING INSTRUMENTS

An auditory blending test was administered for the purpose of selecting good and poor blenders. An auditory screening test was used to locate and exclude any poor blenders who might have a deficiency in auditory acuity. The scores of the reading tests administered by the teachers at the year-end were used as measurements of reading ability, in word recognition, and in comprehension. The examiner administered a battery of tests in order to assess various abilities and characteristics which would appear to be related to blending ability. Each test will be described and the purpose for giving the test stated.

The Roswell-Chall Auditory Blending Test gives an estimate of the pupil's ability to blend sounds auditorily into whole words. It is not dependent upon the child's ability to associate sounds with symbols.

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[2] Frank S. Freeman, in The Fifth Mental Measurements Yearbook, ed. Oscar K. Buros (New Jersey: The Gryphon Press, 1964), p. 350.

TABLE I

AREAS AND APTITUDES MEASURED

TESTS	PURPOSE	MODE OF ADMINISTRATION
A. AUDITORY BLENDING		
Roswell-Chall Auditory Blending Test	to select good and poor auditory blenders	oral (individual)
B. READING ACHIEVEMENT		
1. Gates Advanced Primary Tests, Type AWR, Form 2	to measure word recognition	written (group)
2. Gates Advanced Primary Test, Type APR, Form 2	to measure comprehension	written (group)
3. Betts Sight Vocabulary	to measure the extent of the vocabulary of sight words	oral (individual)
4. The Schonell Graded Word Recognition Test	to measure the ability to recognize words out of context	oral (individual)
5. Pronunciation of Nonsense Words	to assess word-analysis skills	oral (individual)
C. SPELLING ACHIEVEMENT		
The Schonell Graded Word Spelling Test, Test A	to measure spelling ability	oral (group)
D. AUDITORY DISCRIMINATION		
1. Wepman Auditory Discrimination Tests	to measure the ability to distinguish between phonemes	oral (individual)
2. Boston University Hearing Sounds in Words	to measure ability to identify separate sounds in spoken words	oral and written (individual)

TABLE I (continued)

TESTS	PURPOSE	MODE OF ADMINISTRATION
3. Hearing Vowel Sounds in Words	to measure ability to differentiate the medial or vowel sound contained within a word	oral (individual)
4. Rhyming Test	to assess ability to rhyme	oral (individual)
E. AUDITORY MEMORY		
1. Auditory Memory Span for Letters	to measure ability to hold a sequence in mind	oral (individual)
2. Auditory Memory Span for Sounds	to measure ability to hold a phonemic pattern in mind	oral (individual)
3. Auditory Memory Span for Rhythm	to measure ability to recall and reproduce a rhythmic pattern of sounds	oral (individual)
F. LATERALITY		
Tests of Lateral Dominance	to determine eye and hand preference	oral (individual)

This test is comprised of three parts, each of which contains ten monosyllabic words to be blended. In Part I words are divided into two sounds, as a - t; in Part II the words are divided into two parts, as f - at; and in Part III the words are divided into three elements, as c - a - t. The sounds are presented at one-second intervals, and the subject is required to name the word formed after putting the sounds together. Sample items are given to ensure that the child understands what is expected of him. The score is the total number of items correctly blended. These raw scores may be then be interpreted as either "inferior" or "adequate." This dichotomy, Aaron asserts, "is not in keeping with reality....Six correct answers, for instance, is considered inferior for a first grader, while seven correct is adequate."[3] This test is not standardized but has been used by other investigators in a longitudinal study supervised by the authors. With reference to its validity Aaron states:

> This test, more an informal inventory than a standardized test, is useful for evaluating a pupil's ability to blend sounds he hears into words. Though the authors do not present convincing data to support the validity of the test, the test is probably valid for this one purpose.[4]

A slight adaptation of this test was devised whereby the testee was required to sit with his back to the examiner as the sounds were pronounced. This prevented the possibility of lip reading.

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[3] Ira E. Aaron, in The Sixty Mental Measurements Yearbook, ed. Oscar K. Buros. (New Jersey: The Gryphon Press, 1965), p. 830.

[4] Aaron, loc. cit.

The _Gates Advanced Primary Test, Type AWR, Form 2_ measures the pupil's skill in word recognition. Forty-eight items of increasing difficulty are presented to the pupil who must select one of four words that correctly relates to an accompanying picture.

The _Gates Advanced Primary Test, Type APR, Form 2_ consists of twenty-six exercises which are comprised of one or more sentences with accompanying pictures. The test measures the pupil's comprehension of short paragraphs by requiring him to follow and carry out certain directions in each exercise. Although the _Gates Primary Reading Tests_ purport to measure different aspects of reading ability, Eller points out that the high intercorrelations of these tests indicate that they are testing almost the same skill and are inadequate as diagnostic instruments. However, he notes that these tests are popular with teachers and administrators because of their ease in administration and interpretation.[5]

The _Betts Sight Vocabulary Test_ is an informal test devised by the author and is based on the _Betts Reading Vocabulary_. The test is a graded list of words ranging in difficulty from the first to the third grade. Ten words at each level are given. It is an individual test and as the pupil reads off the words from one list the examiner records the responses on a second list. Approximately one second is permitted for each word. The total score was recorded for purposes of this study.

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[5] William Eller, in Buros, _op. cit._, p. 793.

This test was given to determine the extent of the child's sight vocabulary. The child who fails to build a large sight vocabulary according to Bond and Tinker will be limited in ability to read in thought units and seriously handicapped in identifying new words, since he will be unable to identify compound words or root words in unfamiliar words.[6]

The Schonell Graded Word Recognition Test is comprised of one hundred words of increasing difficulty which are arranged in ten levels of ten words each. This is an individual test and the pupil continues reading the words until he fails in ten successive words. The total number of words correctly identified may be evaluated in terms of a reading age. This test, as well as determining ability in word recognition skills, may be used in diagnosing difficulties in word identification. The test was standardized in Great Britain and according to McCulloch, "the Schonell tests provide a convenient and reliable testing kit for the teacher or specialist."[7]

This test was given to determine the child's ability to read words out of context and to assess his skill in word analysis. Harris asserts:

> A child must become able to attack new words and to work out their pronunciations and meanings, in order to be self-reliant and independent in reading.[8]

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[6] Bond and Tinker, op. cit., p. 269.

[7] R. W. McCulloch, in The Fifth Mental Measurements Yearbook, ed. Oscar K. Buros. (New Jersey: The Gryphon Press, 1959), p. 652.

[8] Harris, op. cit., p. 323.

Bond and Tinker stress the aspect of independent word recognition.

> The child who has failed to establish effective means of identifying and recognizing words for his level of advancement will be handicapped in all other aspects of reading.[9]

The *Recognition of Nonsense Words Test* was devised by the examiner and the format was similar to that of the *Roswell-Chall Auditory Blending Test*. The words taken from the auditory blending test were revised by changing the initial or final consonant and, in some instances, the vowel. As an example, in Part I, "at" was changed to "ab"; in Part II, "step" was changed to "stip"; and in Part III, "cat" was changed to "dat".

The purpose of this test, in addition to assessing word-analysis techniques, was to discover whether phonic knowledge is applied equally well on words that have no meaning.

The *Schonell Graded Word Spelling Test, Test A* is comprised of one hundred words arranged in increasing levels of difficulty. This test may be administered to a group, but a pupil after failing with eight to ten consecutive words may cease to attempt more words. Therefore, it is necessary for the examiner or an assistant to check the abilities of the children as they write the test. The examiner administers the test orally by reading out the single word first, then using the word in an explanatory sentence and, finally, repeating the single word. The score on this test may be interpreted in terms of a spelling age. This test, according to Nesbit, "provides a convenient

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[9] Bond and Tinker, *op. cit.*, p. 261.

rough check on spelling attainment between ages eight and twelve, and is widely used for this purpose in Britain."[10]

The Wepman Auditory Discrimination Test is an individual test designed to identify children who may have difficulty in making the fine discriminations between phonemes in the English language. Forty paired words are presented orally to the child, who is seated with his back to the examiner. Ten of these pairs are identical, while the other thirty pairs differ by a single phoneme. The child indicates that he recognizes similarity or difference by saying whether the words are the same or different. The total number of pairs of words correctly identified is used as the score.

This test has been standardized and norms are provided. It is recommended by Dicarlo as a test which provides "a quick and accurate assessment of auditory discrimination among children from five to eight years of age."[11]

This test was administered to determine the relationship between auditory discrimination ability and auditory blending ability. The review of the related research revealed inconsistencies in the findings in the relationships between auditory discrimination and reading achievement, and between blending ability and reading achievement. Smith and Dechant have stressed the significance of auditory discrimination when they state:

> The child must be able to distinguish sounds so that he can learn to speak correctly and to associate the appropriate

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[10] John Nesbit, in Buros, op. cit., p. 223.

[11] Louis M. Dicarlo, in Buros, op. cit., p. 941.

> sound with the printed symbol. The ability to discriminate between the various phonetic elements of a word is a skill essential in reading.[12]

Since it is assumed that the auditory blending of sounds is dependent upon the accurate discrimination of sounds, this test was administered to support the assumption that there is a significant relationship between these two functions. The child's clear discrimination among similar sounds would seem to be necessary so that a word part which is heard may be related to a word part stored in the memory as a part of meaningful word wholes. Auditory blending of a series of such word parts would then be possible. Thus, an accurate initial auditory image would seem to be prerequisite to a successful completion of the auditory blending process.

The *Boston University Hearing Sounds in Words Test* consists of three sections. The first two sections of this test were administered. In Section A, the child is required to identify the initial or final sound in a word given orally by the examiner, by circling the appropriate letter from a given multiple choice. In Section B, the child must circle the appropriate word from a given multiple choice that begins and ends like the one given orally by the examiner.

This test was selected to measure the child's ability to identify sounds in spoken words. In addition, it is a measure of the child's ability to associate a sound with a symbol. This is basic to phonic analysis. Pooley suggests that the ability to associate sounds

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[12] Henry P. Smith and Emerald V. Dechant, *Psychology in Teaching Reading* (Englewood Cliffs, Prentice-Hall, Inc., 1961), p. 135.

with symbols into patterns which the child can recognize as words he already knows is a principal learning of the early stages of reading.[13]

The Hearing Vowel Sounds in Words Test, which consists of ten monosyllabic words, was derived from the Botel Reading Inventory. In it the child is required to state which vowel he hears in the word given orally by the examiner. In addition, the child must decide whether the vowel is long or short. Answers were recorded by the examiner on individual record sheets. This aspect of the test is a slight adaptation of the original since the testee is required to record his own answers.

Although information is needed on reliability and validity, Aaron describes the Botel Reading Inventory as a "useful informal test for assessing knowledge and use of word recognition skills."[14]

The purpose of this test was to measure the child's ability to differentiate the medial or the vowel sound contained within the word. Monroe states that vowel discriminations are somewhat more difficult than consonant discrimination since the vowels are usually found in the middle of words.[15] Langman, too, suggests that this association of appropriate letter with various vowel sounds is a source of confusion for the child. In addition, she points out the differences among vowel sounds that exist in the different dialects of language, thus

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[13] Robert C. Pooley, "Reading and the Language Arts," Development In and Through Reading, Sixtieth Yearbook of the National Society for the Study of Education (Chicago: University of Chicago Press, 1961), p. 41.

[14] Ira E. Aaron, in Buros, op. cit., p. 835.

[15] Marion Monroe, Children Who Cannot Read (Chicago: The University of Chicago Press, 1939), p. 119.

compounding the difficulties in sound discrimination.[16] It would appear, then, that this particular problem related to vowels would be a factor in auditory blending and word analysis.

The Rhyming Test was derived from the Stanford-Binet Intelligence Scale. It tests the individual's capacity for recognizing and producing words of similar phonetic sounds. The subject is asked to produce a word that rhymes with the one given by the examiner; for example, the child is asked to give the name of a colour that rhymes with "head." The score is the total number of correct answers.

This test was given for the purpose of assessing the child's rhyming ability which certain authorities insist is a prerequisite for phonic analysis. However, this test may not be an accurate assessment of rhyming ability only, since the child is obliged to supply from memory a word which rhymes with the given word. Nevertheless, Harris asserts that this ability is an important aspect of phonic readiness. He states that the child

> ...should be sensitive to rhymes, should be able to pick out words that rhyme and should be able to supply words to rhyme with a given word. This ability is fundamental to the construction of "word families."[17]

Vernon, too, suggests that rhyming ability is basic to sound discrimination, word analysis, and blending of sounds to form whole words.[18]

The Auditory Memory Span for Letters Test was taken from the Group Diagnostic Reading Aptitude and Achievement Tests by Monroe

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[16] Muriel Potter Langman, "The Reading Process: A Descriptive Interdisciplinary Approach," Genetic Psychology Monographs, LII (August, 1960), pp. 26-27.

[17] Harris, op. cit., p. 331.

[18] Vernon, op. cit., p. 45.

and Sherman. It consists of sixteen nonsense words, which the examiner spells aloud at the rate of one per second. The only adaptation of the original test was that the examiner recorded the letters repeated by the subject. The score was the total number of words correctly spelled back by the testee.

The purpose of this test was to measure the child's ability to hold a sequence in mind, since the blending of phonemes would appear to require this memory function. Langman suggests that "a serious weakness in auditory memory would interfere with the correct reproduction of words...."[19] Vernon cites several findings which showed that backward readers, even with normal intelligence, had poor auditory memory.[20]

The <u>Auditory Memory Span for Sounds Test</u> was adapted from the preceding test, the <u>Auditory Memory Span for Letters</u> test. The letters comprising the nonsense words in this test are arranged in a different sequence, but in terms of familiar speech phonology. The examiner gives the sounds of the letters of the nonsense words and the child is required to repeat as many of the sounds as he can recall. The score is the total number of correct words.

The purpose of this test was to measure the child's ability to hold a phonemic pattern in mind. Ability to retain auditory patterns is necessary for word analysis. According to Monroe:

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[19] Langman, <u>op</u>. <u>cit</u>., p. 28.

[20] Vernon, <u>op</u>. <u>cit</u>., pp. 60-61.

> ...the lack of precision in the discrimination of the temporal sequence of sounds may impede progress in reading. The difficulty may be due to poor retention of auditory patterns so that the patterns cannot be held in mind long enough for temporal analysis. Therefore the child may be able to give separate sounds for each of the letters composing a word but cannot blend the sounds to get the complete word.[21]

The Auditory Memory Span for Rhythm Test was adapted by the investigator from a tone rhythm test used in an experiment conducted by Strauss and Werner[22] to test perseveration in two groups of children. Twelve rhythmic patterns were presented by the examiner by tapping an arborite surface with a twenty-five cent coin. Procedures for giving the test were adapted from Gould.[23] The patterns, consisting of taps of long and short duration, were timed; for example, in the pattern . . - -, the dot was given a timing of one-half second and the dash a timing of one second. An improvised screen prevented the child from observing the movements made by the examiner.

The investigator's purpose in presenting this test was to assess the child's ability to recall and reproduce a pattern of sounds and to examine Vernon's hypothesis that:

> The inability to blend speech sounds correctly to form words may be due in part to poor perception of temporal order and rhythm.[24]

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[21] Monroe, op. cit., p. 107.

[22] Alfred A. Strauss and Laura E. Lehtinen, Psychopathology and Education of the Brain-Injured Child (New York: Grune and Stratton, 1947), p. 51.

[23] Dulce Eva Gould, "An Investigation into the Relationship of Rhythmic Ability and Reading Achievement," (unpublished Master's thesis, University of Alberta, Edmonton, Alberta, 1966).

[24] Vernon, op. cit., p. 62.

Tests of Lateral Dominance were devised by the examiner. The various activities were selected on the basis of an examination of the programs suggested by Harris[25] and Bond and Tinker[26] for determining laterality preference. The test consists of ten activities. Six activities are related to eye preference and four activities are related to hand preference. In cases where preferences were not clear on the first performance, the test was repeated twice.

The purpose of this test was to determine eye and hand preference. Although there is no conclusion that mixed dominance is a contributing factor in reading disability, de Hirsch has noted that crossed laterality and failure to establish dominance is a part of the syndrome of perceptual-motor difficulties.[27]

IV. METHOD OF ADMINISTRATION

The battery of individual tests used in this study was administered by the investigator during the months of May and June, 1966. One-half to three-quarters of an hour was required for the administration of these tests to each subject. All individual tests were marked by the investigator. The group intelligence tests and group reading tests were administered and marked by the classroom teachers.

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[25] Harris, *op. cit.*, p. 259.

[26] Bond and Tinker, *op. cit.*, p. 101.

[27] Katrina de Hirsch, "Gestalt Psychology as Applied to Language Disturbances," *Journal of Nervous and Mental Diseases*, CXX (September-October, 1954), p. 258.

V. TREATMENT OF THE DATA

The raw scores made by the students were punched on data cards and processed by the computer at the University of Alberta.

To test the first hypothesis that children who have good auditory blending will perform significantly better on reading and spelling achievement tests than will children who have poor auditory blending ability, the means and standard deviations were obtained for the good blenders and poor blenders. Likewise, to test the second hypothesis that children with good blending ability will perform significantly better on aptitude tests assumed to be related to blending ability than will children who have poor auditory blending ability, the means and standard deviations were obtained for the good blenders and poor blenders.

The "t" test for difference in means was applied to determine the differences in error frequency between good blenders and poor blenders. Significance was established at the accepted one per cent and five per cent levels.

To test the third hypothesis and to provide an overall view of the relationships of blending ability with performances on achievement and aptitude tests assumed to be related to blending ability, inter-correlations of all tests were obtained.

To test the fourth hypothesis that blending ability is a significant predictor in reading and spelling achievement, a further analysis of the data was made by applying the analysis of covariance contained within the linear multiple regression technique. The five

significant reading and spelling achievement tests referred to in this study as "performance" variables were used as criteria, and the aptitude tests referred to in this study as "contributing" variables were used as covariates. An investigation of the contribution of each "contributing" variable was made while all other "contributing" variables were held constant. The F ratio test was applied to determine the significance of the differences between variances, thus indicating the importance of each "contributing" variable to the experiment.

CHAPTER V

ANALYSIS OF DATA AND INTERPRETATION OF THE RESULTS

An analysis and interpretation of the data obtained from the testing program administered to good blenders and poor blenders will be discussed in this chapter.

The findings will be presented in the following sequence:

1. A comparison of the means and standard deviations of good blenders and poor blenders on age and intelligence.
2. A comparison of means and standard deviations of good blenders and poor blenders on performances on reading and spelling tests.
3. A comparison of means and standard deviations on performance of good blenders and poor blenders on aptitude tests:
   a. Related Auditory Discrimination Tests
   b. Auditory Memory Span Tests
   c. Laterality Tests
4. Intercorrelations between performances on achievement tests and performances on aptitude tests for good blenders and poor blenders.
5. Analysis of covariance on total scores on performance variables.
6. Independent contributions of "contributing" variables on total scores on performance variables.
7. Summary of the findings.

I. COMPARISON OF MEANS AND STANDARD DEVIATIONS ON AGE AND INTELLIGENCE FOR GOOD BLENDERS AND POOR BLENDERS

The means and standard deviations on age and intelligence for good blenders and poor blenders are shown on Table II. With the mean chronological age of the good blenders at 95.80 months and mean chronological age of poor blenders at 96.24, the difference in means is not significant. There is a significant difference between the two groups in mental age at the .05 level, since the good blenders have a mean mental age of 105.88 months and the poor blenders have a mental age of 98.32 months. Good blenders with a mean I. Q. score of 110.52 show significant superiority in intelligence at .05 level of significance as compared with a mean I. Q. score of 102.36 for the poor blenders.

II. COMPARISON OF MEANS AND STANDARD DEVIATIONS ON PERFORMANCES FOR GOOD BLENDERS AND POOR BLENDERS ON READING AND SPELLING ACHIEVEMENT

Table III presents the means and standard deviations of scores obtained by good blenders and poor blenders on reading and spelling achievement tests. An examination of this table reveals that there is a significant difference at the .01 level in the mean scores of the two groups on tests of word recognition. This indicates the superiority of the good blenders not only in word recognition but also in word analysis skills. The difference between means of the two groups on the <u>Gates Advanced Paragraph Reading</u> is significant at only the .05 level. Therefore, it appears that auditory blending ability is more closely related to word recognition than to silent reading. The fac-

TABLE II

MEAN SCORES FOR CHRONOLOGICAL AGES, MENTAL AGES AND INTELLIGENCE QUOTIENTS FOR GOOD BLENDERS AND POOR BLENDERS

	GOOD BLENDERS		POOR BLENDERS			
	Mean	Standard Deviation	Mean	Standard Deviation	't'	Significance Level
Chronological Age	95.80	3.60	96.24	4.29	0.385	NSD
Mental Age	105.88	11.76	98.32	11.63	2.239	*
Intelligence Quotient	110.52	11.43	102.36	12.01	2.412	*

* Significant at the .05 level, t = 2.01.

** Significant at the .01 level, t = 2.69.

TABLE III

MEAN SCORES FOR READING AND SPELLING TEST RESULTS

FOR GOOD BLENDERS AND POOR BLENDERS

	GOOD BLENDERS		POOR BLENDERS			
Reading Tests	Mean	Standard Deviation	Mean	Standard Deviation	't'	Significance Level
Gates Advanced Word Recognition	36.96	10.29	26.64	10.92	3.370	**
Gates Advanced Paragraph Reading	22.32	7.85	17.24	6.85	2.289	*
Betts Sight Vocabulary	44.40	7.91	40.40	9.47	1.587	NSD
Schonell Word Recognition	34.12	14.83	23.36	8.02	3.126	**
Pronunciation of Nonsense Words	22.16	7.50	13.00	7.01	4.371	**
Schonell Spelling	37.84	14.91	24.36	10.62	3.608	**

* Significant at the .05 level, t = 2.01.

** Significant at the .01 level, t = 2.69.

tor of comprehension is undoubtedly reflected in the silent reading test.

It is noted that there is no significant difference between the two groups on the mean scores on the _Betts Sight Vocabulary_. It is suggested that this test did not provide sufficient scope for the more capable students to demonstrate the extent of their sight vocabulary, since the test did not include words beyond the third grade level. Five good blenders achieved the maximum score of 50 on this test.

The difference in means on scores on the _Schonell Word Spelling Test_ indicates the superiority of good blenders over poor blenders in spelling ability.

III. COMPARISONS OF MEANS AND STANDARD DEVIATIONS ON PERFORMANCES OF GOOD BLENDERS AND POOR BLENDERS ON TESTS OF APTITUDE

1. _Related Auditory Discrimination Tests_

The means and standard deviations for tests of auditory discrimination for good blenders and poor blenders are shown in Table IV. The superiority of good blenders on performances on the first three tests of auditory discrimination is evident at the .01 level of significance. The test of rhyming did not differentiate the groups in this ability since the difference in mean scores did not attain significance. The norms provided for the _Wepman Auditory Discrimination Test_ indicate that good blenders have adequate auditory discrimination ability. Eight-year-old children are considered to have adequate ability in this area if they make no more than three

[illegible]

[illegible]

[illegible]

[illegible]

[illegible]

TABLE IV

MEAN SCORES FOR AUDITORY DISCRIMINATION

TESTS FOR GOOD BLENDERS AND POOR BLENDERS

	GOOD BLENDERS		POOR BLENDERS			
Auditory Tests	Mean	Standard Deviation	Mean	Standard Deviation	't'	Significance Level
Wepman Auditory Discrimination	28.00	1.47	25.56	3.90	2.868	**
Hearing Sounds in Words	32.40	1.20	28.36	5.44	3.553	**
Hearing Vowels in Words	8.84	1.99	6.80	2.84	2.878	**
Rhyming	3.56	0.75	3.44	0.70	0.573	NSD

* Significant at the .05 level, t = 2.01.

** Significant at the .01 level, t = 2.69.

[illegible]

errors on the thirty pairs of words presented to them. On the other hand, it is evident that poor blenders have inadequate auditory discrimination ability since the mean score of 25.56 indicates more than five errors on the test. The tests for _Hearing Sounds in Words_ and _Hearing Vowels in Words_ have not been standardized.

2. _Auditory Memory Span Tests_

Table V reveals that good blenders as indicated by the mean scores on the _Memory Span for Letters_ test and _Memory Span for Sounds_ test had a superior memory span since differences in mean scores favour this group at the .01 level of significance. Since there is no significant difference in the mean scores of good blenders and poor blenders on the _Memory Span for Rhythm_ test, it is assumed that rhythmic ability was reflected by this test and not memory span. Therefore, one can conclude that ability to hold sounds in mind is a factor in blending ability.

3. _Laterality Tests_

Table VI indicates that no significant difference exists between means for the good blenders and poor blenders on tests of laterality. Thus, laterality status is not reflected in auditory blending ability in this investigation.

TABLE V

MEAN SCORES FOR AUDITORY MEMORY SPAN TESTS FOR

GOOD BLENDERS AND POOR BLENDERS

	GOOD BLENDERS		POOR BLENDERS			
Memory Span Tests	Mean	Standard Deviation	Mean	Standard Deviation	't'	Significance Level
Memory Span for Letters	8.00	1.41	6.72	1.18	3.400	**
Memory Span for Sounds	6.28	1.28	4.60	1.13	4.815	**
Memory Span for Rhythm	7.16	3.21	6.12	2.58	1.237	NSD

* Significant at the .05 level, t = 2.01.

** Significant at the .01 level, t = 2.69.

TABLE VI

MEAN SCORES FOR LATERALITY TEST

FOR GOOD BLENDERS AND POOR BLENDERS

	GOOD BLENDERS		POOR BLENDERS			
Test	Mean	Standard Deviation	Mean	Standard Deviation	't'	Significance Level
Test for Laterality	1.60	0.89	1.88	0.99	1.027	NSD

* Significant at the .05 level, t = 2.01.

** Significant at the .01 level, t = 2.69.

IV. INTERCORRELATIONS BETWEEN PERFORMANCES ON ACHIEVEMENT TESTS AND ON APTITUDE TESTS FOR GOOD BLENDERS AND POOR BLENDERS

Table VII on intercorrelations gives an overview of the relationships between performances on achievement tests and performances on aptitude tests assumed to be related to auditory blending ability for good blenders and poor blenders. Age, sex, and I. Q. have been included in this table.

The correlations of auditory blending ability with reading ability are consistent with the evidence presented in Table III where a significant difference in means existed in favour of the good blenders.

A low correlation, which did not reach significance, is shown between blending ability and the score on the Betts Sight Vocabulary. This also is consistent with the evidence in Table III where there was no significance difference in means scores on these tests for the good blenders and poor blenders.

It is observed that auditory blending ability has a slightly higher correlation with spelling ability than with reading ability, except in the instance of the Pronunciation of Nonsense Words. However, this test is a measure of the ability to apply phonic principles rather than a test of word recognition. The pronunciation of nonsense words is dependent upon word attack skills, whereas memory may be a significant factor in the recognition of meaningful words.

Correlations of auditory blending ability with related auditory discrimination abilities are significant at the .01 point. However,

TABLE VII

INTERCORRELATIONS OF READING AND SPELLING ACHIEVEMENT FOR GOOD BLENDERS AND POOR BLENDERS AND OF CERTAIN APTITUDES AND CHARACTERISTICS ASSUMED TO BE RELATED TO AUDITORY BLENDING FOR GOOD BLENDERS AND POOR BLENDERS

	Good Blenders	Poor Blenders
Reading and Spelling Achievement Tests		
1. Gates Advanced A.W.R.	.437**	-.437
2. Gates Advanced A.P.R.	.325**	-.325
3. Betts Sight Vocabulary	.223	-.223
4. Schonell Word Recognition	.411**	-.411
5. Pronunciation of Nonsense Words	.533**	-.533
6. Schonell Spelling Test	.461**	-.461
Aptitude and Characteristics		
Auditory Discrimination Tests		
1. Wepman Auditory Discrimination	.382**	-.382
2. Hearing Sounds in Words	.456**	-.456
3. Hearing Vowel Sounds in Words	.383**	-.383
4. Rhyming Test	.082	-.082
Auditory Memory Span Tests		
1. Auditory Memory Span for Letters	.440**	-.440
2. Auditory Memory Span for Sounds	.570**	-.570
3. Auditory Memory Span for Rhythm	.175	-.175
Laterality Test	-.146	.146
Chronological Age	-.055	.055
Mental Age	.307*	-.307
I. Q.	.328*	-.328
Sex	-.040	.040

* Significant at the .05 level, $r > .28$.

** Significant at the .01 level, $r > .36$.

auditory blending is not correlated significantly with rhyming ability. This was also observed in Table IV, which shows that the differences in means on performances in rhyming did not reach significance for the two groups, whereas differences in means on performance in the other tests of related auditory ability were very significant.

Correlations of auditory blending ability with _Memory Span for Letters_ and _Memory Span for Sounds_ are significant at the .01 level. However, the correlation of auditory blending with _Memory Span for Rhythm_ did not reach significance. This was also noted in Table V.

Auditory blending ability is not correlated with laterality preference. This finding is consistent with the report in Table VI.

Auditory blending ability fails to reach significance in its correlation with the factors of sex and chronological age. It does reach significance in its correlation with I. Q. and mental age at the .05 level.

In review of the intercorrelations between auditory blending ability and tests of achievement, it is observed that auditory blending ability has the highest correlation with the ability to pronounce nonsense words, followed by the next highest correlations with spelling ability and word recognition. These correlations reached the .01 level of significance, while correlation between auditory blending and silent reading reached the .05 level of significance.

In review of the intercorrelations between auditory blending ability and tests of aptitude, it is evident that auditory blending ability correlated highest with _Memory Span for Sounds_, followed by

the next highest correlation with Hearing Sounds in Words, Memory Span for Letters, and Hearing Vowel Sounds in Words, respectively.

Therefore, in summary, blending ability appears to be most highly correlated with word recognition and spelling skills. It is also highly correlated with the aptitude of memory and with the ability to distinguish consonants and vowel sounds in words.

V. ANALYSIS OF COVARIANCE ON TOTAL SCORES ON PERFORMANCE VARIABLES

One purpose of this study was to assess the significance of auditory blending as a predictor in reading and spelling achievement. To determine the contribution of auditory blending ability to reading and spelling achievement, the analysis of covariance contained within the multiple regression technique was applied.

The computer program (PERSUB, 1964), which performs the calculations involved, operates in a stepwise fashion. First, the contributing or predictor variable to be considered is included in a required model, referred to as the unrestricted model. In a second model, referred to as the restricted model, the contributing or predictor variable is excluded, and information is then obtained related to the two squared multiple correlation coefficients. To determine the significance of the difference in the two squared multiple correlations, the F test is used, thereby indicating the importance of the contributing variable to reading and spelling achievement. In the F ratio, $F = (R_1^2 - R_2^2)/df_1 \big/ (1 - R_1^2)/df_2$, where df_1 and df_2 are degrees of freedom for the numerator and

denominator respectively. R_1^2 and R_2^2 are the squared multiple correlations in Model 1 and Model 2, respectively.

An examination of Table VIII reveals that when the analysis of covariance, adjusted for the effect of contributing variables, was applied to the total scores on performance variables, the F-ratio failed to reach significance. Thus, the results of this analysis indicate that auditory blending ability as measured in this investigation cannot be considered to be an effective predictor of reading and spelling achievement in the second year of school.

VI. INDEPENDENT CONTRIBUTIONS OF CONTRIBUTING VARIABLES ON TOTAL SCORES ON PERFORMANCE VARIABLES

The analysis of covariance was extended to assess the relative importance of the contributing variables on total scores on performance variables, thereby indicating their importance as predictors of reading and spelling achievement in the second year of school.

Tables IX, X, and XI, respectively, show that I. Q., auditory discrimination, and memory for sounds are not significant as predictors of performance on achievement tests in the second year of school. Auditory discrimination ability, according to Wepman, is developmental and he suggests that by the eighth year this ability should reach the final stage of maturity.[1] Thus, the finding that auditory discrimination is not a significant predictor of reading and spelling achievement in the second year of school would tend to confirm Wepman's theory.

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[1] Joseph M. Wepman, "Auditory Discrimination, Speech and Reading," The Elementary School Journal, LLX (March, 1960), p. 325.

TABLE VIII

ANALYSES OF COVARIANCE ON TOTAL SCORES ON PERFORMANCE VARIABLES ADJUSTED FOR THE EFFECT OF CONTRIBUTING VARIABLES

Tests	Non-Restricted Squared Multiple Correlation R_1^2	Restricted Squared Multiple Correlation R_2^2	df Num	df Denom	F	Probability Level
Gates A.W.R.	.7775	.7755	1	40	.3516	NSD
Gates A.P.R.	.6956	.6883	1	40	.9620	NSD
Schonell Word Recognition	.6702	.6683	1	40	.2285	NSD
Schonell Spelling	.7192	.7144	1	40	.6863	NSD
Nonsense Words	.7199	.7035	1	40	2.3444	NSD

$$F = \frac{(R_1^2 - R_2^2)/df_1}{(1 - R_1^2)/df_2}$$

* Significant at $p < .05$, $F = 4.08$.

** Significant at $p < .01$, $F = 7.31$.

TABLE IX

INDEPENDENT CONTRIBUTION OF I. Q. ON TOTAL SCORES ON PERFORMANCE VARIABLES ADJUSTED FOR THE EFFECT OF REMAINING CONTRIBUTING VARIABLES AND AUDITORY BLENDING

Tests	Non-Restricted Squared Multiple Correlation R_1^2	Restricted Squared Multiple Correlation R_2^2	df Num	df Denom	F	Probability Level
Gates A.W.R.	.7775	.7710	1	40	1.1731	NSD
Gates A.P.R.	.6956	.6849	1	40	1.4139	NSD
Schonell Word Recognition	.6702	.6656	1	40	.5570	NSD
Schonell Spelling	.7193	.6947	1	40	3.5055	NSD
Nonsense Words	.7199	.7199	1	40	.0015	NSD

$$F = \frac{(R_1^2 - R_2^2)/df_1}{(1 - R_1^2)/df_2}$$

* Significant at $p < .05$, $F = 4.08$.

** Significant at $p < .01$, $F = 7.31$.

TABLE X

INDEPENDENT CONTRIBUTION OF WEPMAN AUDITORY DISCRIMINATION TEST ON TOTAL SCORES OF PERFORMANCE VARIABLES ADJUSTED FOR THE EFFECT OF REMAINING CONTRIBUTING VARIABLES AND AUDITORY BLENDING

Tests	Non-Restricted Squared Multiple Correlation R_1^2	Restricted Squared Multiple Correlation R_2^2	df Num	df Denom	F	Probability Level
Gates A.W.R.	.7775	.7775	1	40	.0000	NSD
Gates A.P.R.	.6956	.6944	1	40	.1584	NSD
Schonell Word Recognition	.6702	.6696	1	40	.0724	NSD
Schonell Spelling	.7192	.7190	1	40	.0329	NSD
Nonsense Words	.7199	.7198	1	40	.0152	NSD

$$F = \frac{(R_1^2 - R_2^2)/df_1}{(1 - R_1^2)/df_2}$$

* Significant at $p < .05$, $F = 4.08$.

** Significant at $p < .01$, $F = 7.31$.

TABLE XI

INDEPENDENT CONTRIBUTION OF MEMORY SPAN FOR SOUNDS ON TOTAL SCORES ON PERFORMANCE VARIABLES ADJUSTED FOR THE EFFECT OF REMAINING CONTRIBUTING VARIABLES AND AUDITORY BLENDING

Tests	Non-Restricted Squared Multiple Correlation R_1^2	Restricted Squared Multiple Correlation R_2^2	df Num	df Denom	F	Probability Level
Gates A.W.R.	.7775	.7707	1	40	1.2219	NSD
Gates A.P.R.	.6956	.6952	1	40	.0478	NSD
Schonell Word Recognition	.6702	.6679	1	40	.2712	NSD
Schonell Spelling	.7192	.7188	1	40	.0547	NSD
Nonsense Words	.7199	.7198	1	40	.0087	NSD

$$F = \frac{(R_1^2 - R_2^2)/df_1}{(1 - R_1^2)/df_2}$$

* Significant at $p < .05$, $F = 4.08$.

** Significant at $p < .01$, $F = 7.31$.

Wepman asserts that the ability to retain individual sounds in mind is essential to the development of auditory discrimination and to the phonic act necessary for reading. Both of these abilities, retention and discrimination, which appear to develop concomitantly, are the final level in the development of audition.[2] Thus the finding that auditory discrimination and memory span for sounds are not predictors of reading and spelling achievement at this stage bears out Wepman's theory.

The remaining contributing variables will be discussed in the order of their effectiveness as predictors of reading and spelling achievement.

Table XII indicates that the ability to discriminate and categorize vowel sounds in words predicts, at the .01 level of significance, reading and spelling achievement in the second year of school. It was pointed out previously that discriminating vowel sounds in words presents a problem for many children. It is assumed, therefore, that ability in this area is useful as a predictor of reading and spelling achievement at the second grade level.

The _Memory Span for Letters Test_ is significant at the .05 level as a predictor of reading and spelling achievement, as shown in Table XIII. It does not predict ability to pronounce nonsense words, that is, the ability to apply phonic knowledge. The fact that memory span for letters is not a predictor of ability to pronounce nonsense words supports the fact that memory depends upon meaningful associations. Thus, although memory span for letters is a contributing

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[2] _Ibid_., pp. 326-327.

TABLE XII

INDEPENDENT CONTRIBUTION OF HEARING VOWEL SOUNDS IN WORDS TEST ON TOTAL SCORES ON PERFORMANCE VARIABLES ADJUSTED FOR THE EFFECT OF REMAINING CONTRIBUTING VARIABLES AND AUDITORY BLENDING

Tests	Non-Restricted Squared Multiple Correlation R_1^2	Restricted Squared Multiple Correlation R_2^2	df Num	df Denom	F	Probability Level
Gates A.W.R.	.7775	.6740	1	40	18.6180	**
Gates A.P.R.	.6956	.6386	1	40	7.4987	**
Schonell Word Recognition	.6702	.6070	1	40	7.6600	**
Schonell Spelling	.7192	.6070	1	40	15.9895	**
Nonsense Words	.7199	.6365	1	40	11.9074	**

$$F = \frac{(R_1^2 - R_2^2)/df_1}{(1 - R_1^2)/df_2}$$

* Significant at $p < .05$, $F = 4.08$.

** Significant at $p < .01$, $F = 7.31$.

[illegible]

TABLE XIII

INDEPENDENT CONTRIBUTION OF MEMORY SPAN FOR LETTERS TEST ON TOTAL SCORES ON PERFORMANCE VARIABLES ADJUSTED FOR THE EFFECT OF REMAINING CONTRIBUTING VARIABLES AND AUDITORY BLENDING

Tests	Non-Restricted Squared Multiple Correlation R_1^2	Restricted Squared Multiple Correlation R_2^2	df Num	df Denom	F	Probability Level
Gates A.W.R.	.7775	.7473	1	40	5.4371	*
Gates A.P.R.	.6956	.6515	1	40	5.8014	*
Schonell Word Recognition	.6702	.6195	1	40	6.1442	*
Schonell Spelling	.7192	.6823	1	40	5.2684	*
Nonsense Words	.7199	.7138	1	40	0.8656	NSD

$$F = \frac{(R_1^2 - R_2^2)/df_1}{(1 - R_1^2)/df_2}$$

* Significant at $p < .05$, $F = 4.08$.

** Significant at $p < .01$, $F = 7.31$.

factor to reading and spelling achievement, as demonstrated in this study, it does not have value as a predictor of the ability to pronounce nonsense words.

Table XIV indicates that the ability to hear sounds in words predicts achievement only in the <u>Gates Advanced Word Recognition Test</u> and the <u>Gates Advanced Paragraph Reading Tests</u> and not in the remaining tests of reading and spelling achievement. It is suggested that although children may have the ability to distinguish initial and final consonants in words, they do not possess, on the whole, at this stage of learning, the ability to analyze and synthesize effectively. These cognitive activities would possibly be required for significant performances on the Schonell tests of word recognition and spelling, and the pronunciation of nonsense words. Since the ceilings of Schonell tests reach a higher grade level than do the Gates tests, the cognitive processes required for significant skill in word attack and in spelling would be reflected in the higher ratings attained on the Schonell tests. It was pointed out previously that the pronunciation of nonsense words, too, depends upon skill in word attack.

The sex variable may be considered as a predictor at the .05 level only on the Schonell tests of word recognition and spelling, as shown in Table XV. It has already been pointed out that possibly these particular tests require a higher level of maturity for significant performance than do the Gates tests. The fact is well documented that girls demonstrate greater linguistic ability than do boys

[illegible]

TABLE XIV

INDEPENDENT CONTRIBUTION OF HEARING SOUNDS IN WORDS TEST ON TOTAL SCORES ON PERFORMANCE VARIABLES ADJUSTED FOR THE EFFECT OF REMAINING CONTRIBUTING VARIABLES AND AUDITORY BLENDING

Tests	Non-Restricted Squared Multiple Correlation R_1^2	Restricted Squared Multiple Correlation R_2^2	df Num	df Denom	F	Probability Level
Gates A.W.R.	.7775	.7533	1	40	4.3504	*
Gates A.P.R.	.6956	.6577	1	40	4.9867	*
Schonell Word Recognition	.6702	.6663	1	40	.4680	NSD
Schonell Spelling	.7193	.7002	1	40	2.7148	NSD
Nonsense Words	.7199	.6947	1	40	3.5966	NSD

$$F = \frac{(R_1^2 - R_2^2)/df_1}{(1 - R_1^2)/df_2}$$

* Significant at $p < .05$, $F = 4.08$.

** Significant at $p < .01$, $F = 7.31$.

[illegible]

TABLE XV

INDEPENDENT CONTRIBUTION OF SEX ON TOTAL SCORES ON PERFORMANCE VARIABLES ADJUSTED FOR THE EFFECT OF REMAINING CONTRIBUTING VARIABLES AND AUDITORY BLENDING

Tests	Non-Restricted Squared Multiple Correlation R_1^2	Restricted Squared Multiple Correlation R_2^2	df Num	df Denom	F	Probability Level
Gates A.W.R.	.7775	.7561	1	40	3.8575	NSD
Gates A.P.R.	.6956	.6673	1	40	3.7241	NSD
Schonell Word Recognition	.6702	.6200	1	40	6.0861	*
Schonell Spelling	.7192	.6823	1	40	5.2704	*
Nonsense Words	.7199	.7050	1	40	2.1303	NSD

$$F = \frac{(R_1^2 - R_2^2)/df_1}{(1 - R_1^2)/df_2}$$

* Significant at $p < .05$, $F = 4.08$.

** Significant at $p < .01$, $F = 7.31$.

at the primary level.[3] This ability is presumably reflected in the Schonell tests of word recognition and spelling. Therefore, it can be predicted that girls will perform significantly better than boys in the second year of school on those tests requiring more advanced linguistic and cognitive skills. Since sex is not a predictor of performance in the pronunciation of nonsense words, it could be postulated that neither of the sexes has attained that level of maturity required for the significant application of phonic principles.

Table XVI reveals that mental age is a predictor of spelling achievement only. It must be pointed out that aural-oral maturity is a factor in spelling achievement. In addition, Bradford found a consistent relationship between aural-oral maturity and mental age.[4] Thus, it is apparent that mental age might be useful in predicting spelling achievement.

VII. SUMMARY

The analysis of the data commenced with a comparison of the means of the ages and the I. Q. scores of the good blenders and the poor blenders. Then a comparison of the mean scores and standard deviations on performances of the two groups on reading and spelling achievement tests was made. This was followed by a comparison of the

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[3] Vernon, _op_. _cit_., p. 114; Dechant, _op_. _cit_., p. 74.

[4] Henry Bradford, "Oral-Aural Differentiation Among Basic Speech Sounds as a Factor in Spelling Readiness," _The Elementary School Journal_, XLIV (February, 1954), p. 358.

TABLE XVI

INDEPENDENT CONTRIBUTION OF MENTAL AGE ON TOTAL SCORES ON PERFORMANCE VARIABLES ADJUSTED FOR THE EFFECT OF REMAINING CONTRIBUTING VARIABLES AND AUDITORY BLENDING

Tests	Non-Restricted Squared Multiple Correlation R_1^2	Restricted Squared Multiple Correlation R_2^2	df Num	df Denom	F	Probability Level
Gates A.W.R.	.7775	.7570	1	40	3.6846	NSD
Gates A.P.R.	.6956	.6701	1	40	3.3535	NSD
Schonell Word Recognition	.6702	.6457	1	40	2.9772	NSD
Schonell Spelling	.7193	.6724	1	40	6.6789	*
Nonsense Words	.7199	.7172	1	40	.3812	NSD

$$F = \frac{(R_1^2 - R_2^2)/df_1}{(1 - R_1^2)/df_2}$$

* Significant at $p < .05$, F = 4.08.

** Significant at $p < .01$, F = 7.31.

mean scores and standard deviations on measures of aptitudes assumed to be related to auditory blending ability.

An assessment was made of the intercorrelations obtained for the achievement and aptitude tests and the factors of I. Q., sex, and age.

Finally, the analyses of covariance indicated the importance of auditory blending and independent contributing variables as predictors of reading and spelling achievement.

In general, the findings resulting from the interpretation of the data are as follows:

1. Good blenders had significantly higher mental ages and I. Q.'s than did poor blenders.
2. Good blenders scored significantly higher than did poor blenders on reading and spelling achievement tests.
3. Good blenders scored significantly higher on tests measuring auditory discrimination than did poor blenders.
4. Good blenders scored significantly higher on tests measuring auditory memory span than did poor blenders.
5. There was no significant difference between good blenders and poor blenders on tests measuring sight vocabulary, memory for rhythm, ability to rhyme, and in laterality preference.
6. For good blenders and poor blenders tests of reading and spelling showed that auditory blending ability had the highest correlation with the ability to pronounce nonsense words, spelling, and word recognition, respectively.

7. For good blenders and poor blenders, tests of aptitude showed that auditory blending ability had the highest correlation with auditory memory span and hearing sounds in words.
8. For good blenders and poor blenders, auditory blending ability was not a significant predictor of reading and spelling achievement in the second year of school.
9. Achievement by good blenders and poor blenders in reading and spelling in the second year of school depended very significantly upon the ability to recognize and categorize vowel sounds in words, and, to a lesser degree, upon memory span for letters.

CHAPTER VI

SUMMARY, CONCLUSIONS, AND IMPLICATIONS

This chapter contains a summary of the study, and the conclusions derived from the findings. Implications for the teaching of reading and suggestions for further research are considered.

I. SUMMARY

Skill in phonic analysis provides the individual with a tool which aids him in the identification and pronunciation of written words. However, several authorities have attested to the fact that many children experience difficulty in phonic analysis of words because they lack the ability to blend or synthesize sounds to form words.

The purpose of this study was to determine certain aptitudes and characteristics which might be related to auditory blending ability, and to determine the relationship between auditory blending ability and reading achievement of children who were in their second year of school.

For this investigation, two groups of children were selected: the good blenders, twenty-five children who scored highest; and the poor blenders, twenty-five children who scored lowest on the *Roswell-Chall Auditory Blending Test*. A screening test for hearing acuity was administered to the poor blenders by means of the Maico audiometer. To the two groups of children, a battery of tests was administered

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individually to measure certain aptitudes and abilities assumed to be related to auditory blending ability and to measure reading and spelling achievement. Intelligence test scores, chronological age, and the scores of the Gates Advanced Primary Tests were obtained from the school records.

The data obtained from the results of the testing program were processed at the Computing Centre at the University of Alberta. The differences of the means and standard deviations of scores of the good blenders and poor blenders were obtained. The 't' test of significance was used and the null hypothesis was rejected if the level of significance was lower than the .05 level. Intercorrelations obtained gave an overview of the relationships among the achievement and aptitude tests and the factors of I. Q., sex, and age. The analysis of covariance contained within the technique of multiple linear regression was used to determine the significance of auditory blending ability in reading and spelling achievement. The investigation was extended to assess the importance of the aptitudes tested and the factors of I. Q., sex, and age to reading and spelling achievement. The F-ratio test was applied, thus indicating the value of these aptitudes or factors as predictors of reading and spelling achievement. The findings derived from these analyses are discussed in the following section in terms of the conclusions drawn from the hypotheses.

II. CONCLUSIONS

Hypothesis I

> Children who have good auditory blending ability will perform significantly better on reading and spelling achievement tests than will children who have poor auditory blending ability.

The null hypothesis corresponding to research Hypothesis I is:

> There is no significant difference between the mean scores of good blenders and the mean scores of poor blenders on:
> (a) The Gates Advanced A. W. R. Test
> (b) The Gates Advanced A. P. R. Test
> (c) Betts Sight Vocabulary Test
> (d) Schonell Graded Word Recognition Test
> (e) Pronunciation of Nonsense Words
> (f) Schonell Graded Spelling Test.

The findings showed that with the exception of *Betts Sight Vocabulary Test* good blenders perform significantly better than poor blenders on reading and spelling achievement tests. The null hypothesis, except for *Betts Sight Vocabulary Test*, is rejected. As indicated previously, the ceiling on this test did not permit accurate measure of the ability of good blenders.

It is concluded from an examination of the means and standard deviations that good blenders show marked superiority over poor blenders in word recognition and word analysis skills. To a lesser degree, good blenders showed superiority in silent reading over poor blenders.

Hypothesis II

> Children who have good auditory blending ability will perform significantly better on tests of aptitudes assumed to be related to auditory blending ability than will children who have poor auditory blending ability.

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The null hypothesis corresponding to research Hypothesis II is:

There is no significant difference between the mean scores of good blenders and the mean scores of poor blenders on:

a. Auditory Discrimination Tests

  i. Wepman Auditory Discrimination Test
  ii. Hearing Sounds in Words Test
  iii. Hearing Vowel Sounds in Words Test
  iv. Rhyming Test

b. Auditory Memory Span Tests

  i. Auditory Memory Span for Letters Test
  ii. Auditory Memory Span for Sounds Test
  iii. Auditory Memory Span for Rhythm Test

c. Laterality Test.

The analysis showed that with the exception of the Rhyming and Auditory Memory Span for Rhythm tests, good blenders possess superior auditory discrimination abilities and memory spans. Laterality status does not differentiate the good blenders from the poor blenders. Therefore, the null hypothesis corresponding to Hypothesis II is rejected except for the variables of rhyming, auditory memory span for rhythm, and laterality.

It is suggested that in the second year of school children have reached a general level of performance in the ability to rhyme; hence there was no difference in ability between the two groups. Rhythmic ability and laterality status failed to distinguish good blenders from poor blenders. De Hirsch[1] noted that dyslexic children had much difficulty in integrating the components of a pattern into a whole. Consequently, they were unable to blend sounds into recognizable wholes, and to reproduce rhythmic patterns. In addition, they often

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[1] De Hirsch, *op. cit.*, p. 261.

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failed to establish dominance or had mixed preferences. It is concluded that in this investigation, since poor blenders are not significantly different from good blenders in these aptitudes, this particular group of poor blenders had little communality with the children De Hirsch has referred to, or to the children involved in Huset's[2] study who exhibited signs of neurophysiological defect or a developmental lag.

Hypothesis III

> There is a significant relationship between auditory blending ability and reading and spelling achievement, and between auditory blending ability and certain aptitudes and characteristics assumed to be related to auditory blending ability.

The null hypothesis corresponding to research Hypothesis III is:

> There is no significant relationship between auditory blending ability and reading and spelling achievement, and between auditory blending ability and certain aptitudes and characteristics assumed to be related to auditory blending ability as in the following:
> (a) Gates Advanced A. W. R. Test
> (b) Gates Advanced A. P. R. Test
> (c) Betts Sight Vocabulary Test
> (d) Schonell Word Recognition Test
> (e) Pronunciation of Nonsense Words
> (f) Schonell Spelling Test
> (g) Wepman Auditory Discrimination Test
> (h) Hearing Sounds in Words Test
> (i) Hearing Vowel Sounds in Words Test
> (j) Rhyming Test
> (k) Auditory Memory Span for Letters Test
> (l) Auditory Memory Span for Sounds Test
> (m) Auditory Memory Span for Rhythm Test
> (n) Laterality Test
> (o) Chronological Age
> (p) Mental Age
> (q) I. Q.
> (r) Sex.

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[2] Huset, *op. cit.*, p. 117.

An examination of the intercorrelations of scores revealed that the findings from this hypothesis are generally consistent with the findings related to Hypothesis I and II. The null hypothesis is rejected except for (c), (j), (m), (n), and (o).

The findings from these intercorrelations show that, with respect to reading achievement, auditory blending is correlated most highly with the ability to pronounce nonsense words, that is, word analysis ability. To a lesser degree, auditory blending is correlated significantly with word recognition and silent reading. These findings are generally in accord with those of Mulder and Curtin[3] and Chall, Roswell, and Blumenthal.[4] Chall *et al* found that auditory blending ability was most highly correlated with word analysis skills, followed by the next highest correlations with oral and silent reading, respectively. Hardy[5] found a significant relationship between auditory blending ability and oral reading only, thus indicating a closer relationship to skill in word recognition as indicated in this study. However, on the other hand, Hardy found an insignificant relationship between blending ability and spelling, while the correlations in this study demonstrate a very significant relationship between auditory blending ability and spelling ability.

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[3] Mulder and Curtin, *op*. *cit*., p. 12.

[4] Chall, Roswell, and Blumenthal, *op*. *cit*., p. 116.

[5] Hardy, *op*. *cit*., p. 60.

A review of the intercorrelations between auditory blending ability and tests of aptitude demonstrates a significant relationship between auditory blending ability and auditory discrimination abilities. In addition, auditory blending ability is strongly correlated with memory span for sounds and letters. It is concluded, then, that auditory blending ability depends upon auditory memory span and upon the ability to distinguish consonant and vowel sounds in words. This conclusion lends support to the behavioural definition given previously to auditory blending.

Auditory blending ability is not significantly related to chronological age or to sex, but is significantly correlated with I. Q. and mental age at this stage. This finding is supported by Chall *et al*,[6] who found an insignificant relationship between I. Q. and blending ability at the first grade level, but found a substantial relationship between auditory blending and I. Q. at the Grade 2/3 level.

Hypothesis IV

> Auditory blending ability is a significant predictor of reading and spelling achievement.

The null hypothesis corresponding to Hypothesis IV is:

> Auditory blending ability is not a significant predictor of reading and spelling achievement.

This null hypothesis was accepted. This finding lends support generally to Reynold's[7] finding, who demonstrated that auditory blending

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[6] Chall, *et al*, *op*. *cit*., p. 117.

[7] Reynolds, *op*. *cit*., p. 445.

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ability was unrelated to general ability except in one school out of the four which he tested, where it was found to be related to word recognition. When Dykstra[8] applied the technique of multiple regression, which was also used in the present investigation, he demonstrated that auditory blending ability was not a predictor of reading ability at the first grade level. Thus, it is concluded that although there is a relationship between auditory blending ability and reading ability, good blenders possess certain aptitudes which poor blenders do not possess. These aptitudes contribute to achievement in reading and spelling in the second year of school.

III. ADDITIONAL FINDINGS AND CONCLUSIONS

1. For good blenders and poor blenders, I. Q. is not a significant predictor of reading and spelling achievement in the second year of school.
2. For good blenders and poor blenders, auditory discrimination ability, as measured by _Wepman Auditory Discrimination Test_ and _Memory Span for Sounds_, is not a significant predictor of reading and spelling achievement in the second year of school. This finding supports Wepman's theory that this perceptual ability, auditory discrimination and retention, "which has been demonstrated to have its own rate of development, may continue to mature through the eighth year of life."[9] Therefore, it is

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[8] Robert Dykstra, "Auditory Discrimination Abilities and Beginning Reading Achievement," _Reading Research Quarterly_, I (Spring, 1966), p. 26.

[9] Joseph M. Wepman, "The Interrelationship of Hearing, Speech and Reading," _The Reading Teacher_, XIV (March, 1961), p. 246.

concluded that at the end of the second year of school, auditory discrimination ability, as measured by Wepman's Auditory Discrimination Test, has reached a general level of maturity and is no longer a significant predictor of reading and spelling achievement.

3. For good blenders and poor blenders, ability to distinguish vowel sounds is a strong predictor of reading and spelling achievement in the second year of school. It was previously pointed out that vowel sounds are a source of confusion for many children. Langman asserts:

> For poor readers, some differences in vowel sounds are difficult to reproduce, and difficult also to associate with the appropriate letter in word analysis and spelling.... ability to tell the name of the medial vowel that represents the sound in question (whether to spell rest with an a, an e, or an i, for example) is a common and stubborn problem.[10]

It must be pointed out, that in this investigation, the failure to categorize the vowel sounds as long or short sounds precluded success on the Hearing Vowel Sounds in Words Test.

4. For good blenders and poor blenders, Memory Span for Letters was found to be a significant predictor of reading and spelling achievement in the second year of school. Several authorities testify to the importance of memory span in reading achievement and to the lack of it in poor readers. Langman refers to the importance of this aptitude for reading when she states:

> Auditory memory, on which association between a sound and a letter name and form depends, is also poorer in poor readers than in the general population.[11]

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[10] Langman, op. cit., p. 27.

[11] Ibid., p. 28.

5. It is observed that in the second year of school many children have developed a certain proficiency in sound-symbol relationship, but they fail to utilize this knowledge because they are unable to analyze or synthesize.
6. In the groups of good blenders and poor blenders, girls demonstrate superiority over boys in word recognition and spelling ability in the second year of school.
7. Mental age of good blenders and poor blenders is reflected in spelling ability in the second year of school.

IV. IMPLICATIONS FOR TEACHING READING

1. Auditory blending ability, as measured in this investigation, does not appear to warrant the emphasis that some authorities would give it. It would appear that time spent on developing this technique might well be spent on other activities related to reading and spelling achievement.
2. The indication that auditory blending ability is not a significant factor in reading and spelling achievement for good blenders and poor blenders in the second year of school implies that a deductive phonic approach to teaching reading which places emphasis on the sound-symbol relationship and the blending of word elements should perhaps be carefully examined.
3. Although auditory blending ability may not be a prerequisite for reading achievement in the second year of school, there may be merit in developing this skill in those children who learn best through an auditory approach or for those particular cases where

the child experiences difficulty in seeing the 'Gestaltan,' or for the child who has poor visual memory.

4. Since the auditory blending of phonic elements does not appear to be a significant factor in reading and spelling achievement, it is suggested that an approach to reading which introduces word-spelling patterns in a sequential manner may have merit. Emphasis would probably be placed on the vowel sounds in these patterns to develop correct pronunciation and spelling.
5. In view of the apparent importance of vowel sounds at the second year level, it is suggested that teaching of vowels and vowel sounds might be introduced at the first grade level. In any event, a program of readiness which includes listening and the discrimination of vowel sounds should be initiated. Since vowels strongly influence the correct pronunciation and meaning of words, attention should be given to those linguistic elements so that the child, for example, will not refer to "tint" as "something to sleep in."
6. On the basis of the findings of this study, that memory span contributes to success in reading and spelling achievement, it appears that games and techniques should be employed to attempt to develop this aptitude in kindergarten and in the first grade.
7. Readiness tests for the first grade which include measures of memory span and of auditory discrimination may have value.

V. RECOMMENDATIONS

1. Since relatively few studies have been conducted on auditory blending, and these limited to disabled readers or to school-age children, it is suggested that further investigations might be undertaken at the pre-school or kindergarten level using the total distribution of a normal population.
2. There is a need for further study related to auditory perception. It is evident that auditory memory and auditory discrimination have many facets. The number and nature of these facets might be explored through the multiple regression technique to determine their predictive value to reading achievement.
3. Investigations related to hearing acuity in the primary grades are needed. This study and others report that at least eight to ten per cent of the normal population tested in local schools have hearing deficiencies.
4. Further study related to the discrimination and categorization of vowel sounds is suggested to determine the contribution of each aspect to reading achievement.
5. Experimental studies might be conducted in Grade I to determine the value of introducing vowels and vowel sounds at this level.

VI. CONCLUDING STATEMENT

In this investigation, the relationship between auditory blending and reading and spelling achievement has been examined. In addition, the relationship between auditory blending ability and

certain aptitudes assumed to be related to auditory blending ability were also studied. The findings derived through the multiple linear regression technique revealed that auditory blending ability is not significant as a predictor of reading and spelling achievement. It was found that the ability to discriminate and categorize vowel sounds in words and, to a lesser degree, memory span for letters were significant predictors of performances in reading and spelling in the second year of school.

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APPENDIX

Roswell-Chall

AUDITORY BLENDING TEST

by

Florence G. Roswell
The City College of
The City University of New York

and

Jeanne S. Chall
Harvard University
Cambridge, Mass.

Name ______________________________

Boy _____ Girl _____ Age(yrs.) _____ (mos.) _____

Grade _____ School ______________________

Examined by ______________ Date of Test ______________

Total Raw Score ________

Auditory Blending Ability
Adequate Blending ☐
Inadequate Blending ☐

Where examined ______________________________

TO THE EXAMINER: See Manual of Instructions for explicit directions regarding administration, recording, and interpretation of results.

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SAMPLE WORDS: s - ing, t - op, s - i - t

Part I		Part II		Part III	
1. a - t	____	11. st - ep	____	21. c - a - t	____
2. n - o	____	12. f - at	____	22. b - i - g	____
3. i - f	____	13. pl - ay	____	23. c - u - ff	____
4. u - p	____	14. b - oat	____	24. s - a - d	____
5. s - ay	____	15. ch - ain	____	25. g - o - t	____
6. m - y	____	16. b - ed	____	26. m - a - p	____
7. b - e	____	17. c - ake	____	27. r - u - g	____
8. t - oo	____	18. r - an	____	28. d - e - sk	____
9. c - ow	____	19. t - ime	____	29. t - oa - st	____
10. h - e	____	20. c - all	____	30. p - e - t	____

Number Correct Part I ________

Number Correct Part II ________

Number Correct Part III ________

Total Raw Score ________________
(total number correct for part I + II + III)

Comments ______________________________
____

Adequate Blending ☐

Inadequate Blending ☐
(check one)

INDIVIDUAL WORD RECOGNITION TEST

Name ______________________________ Age ________ Date _______________

(The following is based on Betts' READING VOCABULARY STUDY and arranged in order of frequency or occurrence.)

INSTRUCTIONS: An abbreviated test may be administered by using the first ten words in each column. Check (✓) all correct responses; mark with a zero (0) a failure to respond; record all incorrect responses.

Pre-Primer Level	Primer Level	First Reader Level	Second Reader Level	Third Reader Level
1. the	1. with	1. old	1. dress	1. heard
2. a	2. me	2. took	2. noise	2. beautiful
3. mother	3. for	3. water	3. bark	3. clothe
4. is	4. he	4. way	4. string	4. kept
5. I	5. we	5. many	5. through	5. hot
6. to	6. my	6. again	6. side	6. really
7. and	7. away	7. know	7. knew	7. hundred
8. said	8. can	8. over	8. cook	8. careful
9. come	9. like	9. other	9. air	9. also
10. you	10. are	10. next	10. tire	10. wonderful

Score __________

THE SCHONELL GRADED WORD READING TEST

tree	little	milk	egg	book
school	sit	frog	playing	bun
flower	road	clock	train	light
picture	think	summer	people	something
dream	downstairs	biscuit	shepherd	thirsty
crowd	sandwich	beginning	postage	island
saucer	angel	ceiling	appeared	gnome
canary	attractive	imagine	nephew	gradually
smoulder	applaud	disposal	nourished	diseased
university	orchestra	knowledge	audience	situated
physics	campaign	choir	intercede	fascinate
forfeit	siege	recent	plausible	prophecy
colonel	soloist	systematic	slovenly	classification
genuine	institution	pivot	conscience	heroic
pneumonia	preliminary	antique	susceptible	enigma
oblivion	scintillate	satirical	sabre	beguile
terrestrial	belligerent	adamant	sepulchre	statistics
miscellaneous	procrastinate	tyrannical	evangelical	grotesque
ineradicable	judicature	preferential	homonym	fictitious
rescind	metamorphosis	somnambulist	bibliography	idiosyncrasy

SCORE ____________

NAME ________________________________ TEACHER ______________________________

THE PRONUNCIATION OF NONSENSE WORDS TEST

1. ab	11. stip	21. dac
2. mo	12. gat	22. hig
3. ig	13. flay	23. luff
4. ud	14. doat	24. rad
5. tay	15. chail	25. gop
6. ky	16. yed	26. mab
7. de	17. nake	27. wug
8. roo	18. han	28. pesk
9. pow	19. sime	29. joast
10. ne	20. rall	30. vet

Score ______________________

(Number of nonsense words correct)

NAME ______________________________ TEACHER __________________________

THE SCHONELL GRADED WORD SPELLING TEST A

net	can	fun	top	rag
sat	hit	lid	cap	had
let	doll	bell	yes	then
may	tree	by	ill	egg
land	how	your	cold	talk
flower	son	seem	four	loud
ground	lowest	brain	write	amount
noise	remain	hoped	worry	dancing
damage	else	through	entered	cough
fitted	spare	daughter	edge	search
concert	domestic	topic	method	freeze
avoid	duties	recent	type	instance
liquid	assist	readily	guess	attendance
description	welfare	various	genuine	interfere
accordance	mechanical	anxious	signature	allotment
approval	accomplished	remittance	financial	capacity
surplus	exceptionally	successful	preliminary	resource
prologue	colonel	coarse	referring	courteous
exhibition	affectionately	attorney	pinnacle	toboggan
definite	guarantee	anniversary	irresistible	hydraulic

Score ______________

NAME ______________________________ TEACHER ___________________________

AUDITORY DISCRIMINATION TEST

FORM I

			X	Y
1.	tub	- tug		
2.	lack	- lack		
3.	web	- wed		
4.	leg	- led		
5.	chap	- chap		
6.	gum	- dumb		
7.	bale	- gale		
8.	sought	- fought		
9.	vow	- thou		
10.	shake	- shape		
11.	zest	- zest		
12.	wretch	- wretch		
13.	thread	- shred		
14.	jam	- jam		
15.	bass	- bath		
16.	tin	- pin		
17.	pat	- pack		
18.	dim	- din		
19.	coast	- toast		
20.	thimble	- symbol		

			X	Y
21.	cat	- cap		
22.	din	- bin		
23.	lath	- lash		
24.	bum	- bomb		
25.	clōthe	- clōve		
26.	moon	- noon		
27.	shack	- sack		
28.	sheaf	- sheath		
29.	king	- king		
30.	badge	- badge		
31.	pork	- cork		
32.	fie	- thigh		
33.	shoal	- shawl		
34.	tall	- tall		
35.	par	- par		
36.	pat	- pet		
37.	muff	- muss		
38.	pose	- pose		
39.	lease	- leash		
40.	pen	- pin		

	X	Y
Error Score	/30	/10

Name of Child:

Date Tested: Examiner's Name:

Age: Date of Birth:

Grade: Name of School:

Disabilities: Hearing:

Reading:

Speaking:

Other:

I.Q.: Test:

Error Score:

	X	Y
Form C	/30	/10
Form D	/30	/10

Additional Comments:

TEST FOR HEARING SOUNDS IN WORDS

A.		B.			
1.	p b t n a	1.	garrulous	pertain	warrant
2.	e p c d t	2.	milligram	sweltering	shrapnel
3.	d f g v h	3.	chemist	stereogram	hydrocarbon
4.	g k v l i	4.	ponderous	spectacular	military
5.	k r b d s	5.	finesse	intended	rebuff
6.	o s n b t	6.	linoleum	periwinkle	cacophony
7.	y l d f g	7.	brethren	noblemen	burlesque
8.	f t i r b	8.	premium	gypsyism	glaucoma
9.	c d k m i	9.	hexameter	generation	hydrogen
10.	f v p h o	10.	proficient	presumptive	dominant
11.	l v n t u	11.	cavalry	martinet	castinet
12.	s q r z p	12.	filiform	felonious	deciduous
13.	c m a b o	13.	meander	monotony	rancour
14.	h m s e w	14.	sheathing	shameful	collateral
15.	m v e r a	15.	bronchitis	platonic	breechblock
16.	n e h a o	16.	theorem	reckon	thermion
17.	w q i n e	17.	drammock	druidism	pyrogenic
18.	i l s t y	18.	eroded	chiseled	charbon

Score A ____________________ B ____________________

TOTAL ____________________

NAME ____________________ TEACHER ____________________

HEARING VOWEL SOUNDS IN WORDS TEST

(Adapted from The Botel Reading Inventory)

Samples

1. bug ___ ___	2. fine ___ ___

Test Items

1. bid ___ ___	6. stop ___ ___
2. eve ___ ___	7. bun ___ ___
3. flat ___ ___	8. mile ___ ___
4. note ___ ___	9. best ___ ___
5. cave ___ ___	10. cute ___ ___
	Score __________

Directions

The examiner says, "What vowel do you hear in this word?" The examiner than pronounces the word "bug" and waits for the answer. Then she asks, "Is the vowel sound long or short?" The examiner repeats the procedure for the word "fine." She then proceeds with the test items, recording the symbol the child names and indicating the classification with an "L" or "S". The score is the total number of vowel sounds correctly identified and classified.

NAME ______________________________ TEACHER ______________________________

RHYMING TEST

(Stanford-Binet Intelligence Scale)

Procedure

Say, "You know what a rhyme is, of course. A rhyme is a word that sounds like another word. Two words rhyme if they end in the same sound, like 'hat' and 'sat.' Now I want you to:

(a) Tell me the name of a color that rhymes with 'head.'

(b) Tell me a number that rhymes with 'tree.'

(c) Tell me the name of an animal that rhymes with 'fair.'

(d) Tell me the name of a flower that rhymes with 'nose.'"

Score ____________

NAME ____________________________ TEACHER __________________________

AUDITORY MEMORY SPAN FOR LETTERS TEST

(Adapted from Group Diagnostic Reading Aptitude and Achievement Tests by Marion Monroe and Eva Sherman)

1. o - m
2. l - u
3. t - a - s
4. m - e - y
5. f - l - o - b
6. s - p - a - g
7. w - h - u - g - g
8. t - r - o - m - e
9. s - k - e - n - a - r
10. g - r - e - v - e - k
11. a - l - i - n - n - a - r
12. y - a - p - r - o - i - f
13. m - a - f - a - p - a - s - o
14. s - q - u - o - g - a - l - t
15. h - e - t - h - o - s - e - l - t
16. b - r - i - a - g - o - n - t - y

Score ______________

(Number of nonsense words correct)

Directions

The examiner says, "I am going to spell aloud the letters of some nonsense words. Listen carefully, and then spell back to me as many of the letters as you can remember." The examiner then spells aloud the letters at the rate of one per second and records the total number of words correctly spelled back by the child.

NAME ______________________________ TEACHER ____________________________

AUDITORY MEMORY SPAN FOR SOUNDS TEST

(Adapted from Auditory Memory Span for Letters Test)

1. m - o
2. u - l
3. a - t - s
4. y - e - m
5. b - o - l - f
6. p - a - g - s
7. g - u - g - w - a
8. r - e - m - o - t
9. e - s - r - a - n - k
10. k - i - v - r - e - g
11. r - i - n - a - l - a - n
12. a - f - o - p - i - r - y
13. s - a - p - e - f - a - m - a
14. t - e - l - a - q - u - o - g - s
15. h - e - s - t - o - h - e - l - f
16. a - n - o - t - y - b - r - i - g

Score ___________

(Number of nonsense words correct)

Directions

The examiner says, "This time I am going to sound aloud the letters of some nonsense words. Listen carefully, and then repeat as many of the sounds as you can remember. The examiner then gives the sounds at the rate of one per second and records the total number of words correctly sounded back by the child.

NAME ______________________________ TEACHER ___________________________

AUDITORY MEMORY SPAN FOR RHYTHM TEST

I. Materials

A chart of rhythmic tone patterns, a screen to prevent the observation of hand movements made by the examiner, a coin (a quarter) for tapping patterns, a small piece of arborite on which to tap the patterns, a stop watch, one pencil

Tapping Patterns

Samples

1. - ** -	2. - - ***

Test Items

1. ** - -	7. - - - **
2. - - **	8. * - ** -
3. *** - -	9. - * - **
4. - ** - -	10. - ** - *
5. ** - - -	11. - - * - *
6. * - - *	12. ** - * -

Total Score __________

II. Timing

\- is equivalent to one second duration.

* is equivalent to one-half second duration.

III. Testing Procedures

A. Directions

The examiner says, "I am going to tap out some sound patterns with this coin. When I stop I would like you to tap out the same pattern with this pencil." The examiner then taps out example (1) and waits for the child to repeat the pattern. The examiner may comment on the child's performance, making suggestions as to the tempo, if necessary. Example (2) is then tapped out. If the child does not understand what he is to do, the instructions and demonstrations may be repeated, using the same examples.

The examiner erects the small screen to hide her hand movements and proceeds, saying: "Listen carefully and then tap. I will tap the pattern only once."

AUDITORY MEMORY SPAN FOR RHYTHM TEST (continued)

B. One mark is allowed for each pattern correctly tapped. The total possible score is 12. It is not essential that the rate of tapping match that of the examiner, but the pattern must be clearly defined.

NAME ______________________________ TEACHER ____________________________

TESTS OF LATERAL DOMINANCE

Materials

A marble, rubber ball, scissors, a deck of cards, a paper cylinder, kaleidoscope, toy gun, cardboard (4"x6") with hole.

Activities with Hand

1. Shooting a marble R ____ L ____
2. Snapping finger and thumb together R ____ L ____
3. Bouncing a ball R ____ L ____
4. Using scissors R ____ L ____
5. Dealing cards R ____ L ____
6. Writing with pencil R ____ L ____

Score R ____%

Activities with Eye

1. Looking through telescope (paper cylinder) R ____ L ____
2. Looking at kaleidoscope R ____ L ____
3. Sighting with gun R ____ L ____
4. Sighting with hole in cardboard R ____ L ____

Score R ____%

Dominance R ____ L ____ Mixed ____

NAME ______________________________ TEACHER ______________________________

ACHIEVEMENT TEST SCORES, CHRONOLOGICAL AGE, MENTAL AGE,

I. Q. AND SEX FOR GOOD BLENDERS

Pupils	Roswell-Chall A.B.	Gates A.W.R.	Gates A.P.R.	Betts Vocabulary	Schonell W.R.	Schonell Spelling	Nonsense Words	C.A.	M.A.	I.Q.	Sex*
1	30	7	4	26	13	18	8	92	86	93	0
2	30	22	10	28	15	18	15	93	111	119	1
3	29	16	5	24	7	8	2	91	90	99	1
4	30	36	14	39	20	21	19	95	95	99	0
5	30	43	29	50	39	36	26	93	113	122	0
6	30	32	21	45	26	30	19	93	106	114	0
7	29	33	24	44	26	32	21	99	120	121	1
8	30	45	30	47	33	45	28	99	117	118	0
9	30	42	24	48	32	38	26	99	100	101	1
10	30	38	23	48	38	31	21	95	91	96	0
11	29	39	25	49	41	49	28	91	111	122	0
12	29	40	22	48	29	29	24	95	113	119	1
13	29	41	19	45	28	31	19	96	110	115	0
14	30	41	29	49	63	52	29	100	123	123	0

* 0--Girls

1--Boys

ACHIEVEMENT TEST SCORES, CHRONOLOGICAL AGE, MENTAL AGE,

I. Q. AND SEX FOR GOOD BLENDERS (continued)

Pupils	Roswell-Chall A.B.	Gates A.W.R.	Gates A.P.R.	Betts Vocabulary	Schonell W.R.	Schonell Spelling	Nonsense Words	C.A.	M.A.	I.Q.	Sex
15	30	44	31	49	44	50	27	101	114	113	0
16	29	48	30	50	65	74	30	101	123	122	1
17	30	47	27	48	34	39	26	96	110	115	1
18	30	44	31	50	45	53	30	98	107	109	0
19	29	47	29	48	38	48	26	99	112	113	1
20	30	39	20	47	31	29	21	90	97	108	1
21	30	36	27	48	28	32	21	90	95	106	0
22	29	36	24	49	35	45	26	97	102	105	0
23	30	19	9	31	15	24	5	99	76	77	1
24	30	46	27	50	65	63	29	92	117	127	0
25	29	43	24	50	43	51	28	101	108	107	1

ACHIEVEMENT TEST SCORES, CHRONOLOGICAL AGE, MENTAL AGE

I. Q. AND SEX FOR POOR BLENDERS

Pupils	Roswell-Chall A.B.	Gates A.W.R.	Gates A.P.R.	Betts Vocabulary	Schonell W.R.	Schonell Spelling	Nonsense Words	C.A.	M.A.	I.Q.	Sex
26	16	20	7	39	19	14	14	90	95	106	1
27	21	32	21	49	29	31	21	94	106	113	1
28	23	19	18	39	23	23	10	92	111	121	1
29	23	31	22	47	26	27	22	94	102	109	1
30	23	40	21	43	28	31	21	91	100	110	1
31	23	39	16	43	21	21	10	97	109	112	1
32	22	29	17	46	26	30	18	96	114	119	0
33	15	39	24	50	36	42	24	100	84	84	0
34	9	21	9	37	18	20	4	107	121	114	0
35	18	20	10	38	17	18	10	96	97	101	0
36	22	26	15	44	26	34	19	93	84	90	0
37	21	18	15	34	20	19	15	92	99	108	1
38	16	38	26	46	30	25	14	92	92	100	0
39	20	44	30	48	40	49	21	99	118	119	0

ACHIEVEMENT TEST SCORES, CHRONOLOGICAL AGE, MENTAL AGE

I. Q. AND SEX FOR POOR BLENDERS (continued)

Pupils	Roswell-Chall A.B.	Gates A.W.R.	Gates A.P.R.	Betts Vocabulary	Schonell W.R.	Schonell Spelling	Nonsense Words	C.A.	M.A.	I.Q.	Sex
40	21	39	27	48	28	30	19	94	95	101	1
41	23	41	26	49	33	38	20	100	113	113	0
42	12	35	20	44	27	28	14	100	104	104	0
43	11	21	12	34	22	14	3	95	105	111	0
44	13	19	19	41	22	15	4	105	95	90	1
45	15	23	20	44	22	24	15	102	85	83	0
46	20	21	15	39	20	20	8	95	92	97	1
47	21	23	13	38	20	23	12	100	78	78	0
48	22	23	20	45	24	29	6	93	90	97	0
49	20	4	3	17	5	3	1	93	81	87	1
50	19	1	5	8	2	1	0	96	88	92	1

APTITUDE TEST SCORES FOR GOOD BLENDERS

Pupils	Wepman A.D.	Hearing Sounds in Words	Hearing Vowel Sounds	Rhyming Test	A.M. Span for Letters	A.M. Span for Sounds	A.M. Span for Rhythm	Laterality*
1	25	30	4	4	8	6	7	3
2	26	32	5	4	7	5	3	1
3	26	29	6	1	4	4	4	1
4	30	29	8	3	8	7	8	1
5	29	33	9	4	8	5	9	1
6	29	32	10	3	7	6	9	1
7	30	33	10	3	9	8	6	3
8	29	33	10	4	6	6	1	1
9	30	33	10	4	7	5	3	1
10	28	33	10	3	7	8	11	1
11	29	33	10	3	8	7	6	1
12	29	33	9	4	7	5	2	1
13	28	33	10	4	7	6	3	3
14	28	33	10	4	10	8	10	1

* 1--Right dominance
2--Left dominance
3--Mixed dominance

APTITUDE TEST SCORES FOR GOOD BLENDERS

(continued)

Pupils	Wepman A.D.	Hearing Sounds in Words	Hearing Vowel Sounds	Rhyming Test	A.M. Span for Letters	A.M. Span for Sounds	A.M. Span for Rhythm	Laterality
15	27	33	10	4	8	6	10	1
16	28	33	10	4	11	6	11	2
17	28	33	10	4	9	6	10	1
18	28	33	10	4	8	6	6	1
19	27	33	10	4	10	8	10	3
20	25	33	10	3	8	4	5	1
21	28	32	5	4	10	8	10	1
22	29	32	10	4	9	6	9	3
23	26	33	5	2	8	5	4	3
24	30	33	10	4	8	8	10	1
25	28	33	10	4	8	8	12	3

APTITUDE TEST SCORES FOR POOR BLENDERS

Pupils	Wepman A.D.	Hearing Sounds in Words	Hearing Vowel Sounds	Rhyming Test	A.M. Span for Letters	A.M. Span for Sounds	A.M. Span for Rhythm	Laterality
26	28	25	9	3	4	3	4	1
27	26	33	10	3	7	4	8	3
28	27	33	5	3	7	5	9	1
29	26	32	8	3	8	5	8	3
30	27	33	8	4	8	4	5	3
31	27	32	10	3	10	6	9	1
32	26	33	10	4	6	5	5	3
33	26	32	10	3	6	2	6	1
34	26	21	4	3	6	5	8	1
35	9	29	2	4	5	4	1	1
36	28	28	4	3	6	5	7	3
37	27	32	8	4	6	5	9	1
38	26	28	7	3	7	4	2	1
39	24	33	10	4	7	5	6	3

APTITUDE TEST SCORES FOR POOR BLENDERS

(continued)

Pupils	Wepman A.D.	Hearing Sounds in Words	Hearing Vowel Sounds	Rhyming Test	A.M. Span for Letters	A.M. Span for Sounds	A.M. Span for Rhythm	Laterality
40	25	30	9	4	8	6	6	3
41	28	33	10	4	7	7	10	1
42	29	32	5	4	6	4	11	1
43	26	22	3	4	8	4	8	1
44	22	27	4	4	6	3	4	1
45	28	30	5	4	7	5	5	3
46	28	26	8	1	6	3	1	1
47	25	26	7	3	7	4	6	3
48	28	31	9	3	8	6	4	1
49	20	14	5	4	6	6	6	3
50	27	14	0	4	6	5	5	3